Canon

Canon A-1 Repair Guide

1. Introduction

In April, 1976, Canon introduced a landmark camera, the Canon AE-1. It incorporated a very reliable computerized AE mechanism into a compact body that can be marketed at a very competitive price due to revolutionary production techniques. The AE-1 has been a huge success and completely changed the face of photo hardware marketing.

With the AE-1 firmly established as the best selling SLR in the World, design work progressed on a more versitile version. This work is now complete and the result is the CANON A-1, the Apex of the AE camera world: the highest quality, most durable, most feature laden automatic exposure SLR in the world.

The major goals which guided the design of the A-1 were:

- Incorporation of advanced digital technology
- Compact, easy-to-handle body
- Compatability with AE-1 system components
- Interchangeability of parts with AE-1
- Improved durability

2. Features

2.1 Five difference automatic exposure modes

o Full Aperture TTL Metering

Shutter speed priority AE

Aperture priority AE

Programmed AE

Electronic flash AE

o TTL Stopped-Down Metering

Stopped-down AE at (regardless of the types of lens attached or whether a lens is attached at all).

2.2 The employment of total digital system to process with speed and accuracy all incoming information

After converting the brightness information from analog form into digital form, digital computation takes care of information input, calculation, information storage,

information display and exposure control.

2.3 Full Information Character Display Viewfinder

All information is displayed alphametricly is the dark area below the focusing screen by segmented LED's similar to those used in digital calculators. Information includes exposure information, mode information, and various warnings. Although it is probably the least intrusive full information viewfinder ever built, it can be turned off to completely eliminate any distraction to focusing and composition. Even when it is turned off, the camera continues to function normally in whichever mode it is in. Details are given later.

2.4 Expanded Range and Versitility

Expanded metering, film speed and shutter speed and exposure compensation ranges, EV memory and multiple exposure increase the A-1's versitility.

2.5 Essential Controls and Displays Grouped for Easy Reach and Rapid Operations

(1) AE mode

(2) AT dial

(3) Shutter button lock self-timer lever

(4) Viewfinder information display switch

(5) Multiple exposure lever

2.6 Automatic System Components

Motor Drive MA, Power Winder A, Data Back A, Speedlites 155A, and 199A.

2.7 Human Engineering, Miscellaneous

- Safety Features: Lock Mechanisms, Flashing Warnings, Energy Conserving Design
- Easy Operation: Action Grip, Human Engineering Design, Electro-magnetic release
- Interchangeable Viewfinder Screens

- o Easy to read viewfinder
- o True-load battery checker gives visual indication of remaining battery power
- o Eyepiece Shutter to block extraneous light
- o Two delay self timer

3. Specifications

3.1 Type:

35mm focal plane shutter single lens reflex with five automatic exposures modes:

3.2 Picture Size: 24 x 36 mm

3.3 Interchangeable Lenses:

Whole FD series for five methods in automatic exposures; with FL series, automatic exposures with stopped-down metering at working apertures.

3.4 Viewfinder

(1)	Type:	Fixed eye-level pentaprism
(2)	Field-of-view:	93.4% vertical and 95.3% horizontal
(3)	Magnification:	0.83X at infinity with 50 mm lens
(4)	Viewfinder Power:	-1.0 dpt (same as the AE-1)

(5) Focusing Screens:

Standard screen is center split-image (2.5 mm diameter with 8^{o} prism angle) rangefinder surrounded by microprism (with 8^{o} prism) and ground glass/fresnel field for the remaining portion. The six focusing screens for replacement are split-image, microprism, microprism for small aperture lenses, all matte, double cross hair reticule and matte/scale.

(6) Viewfinder Information

Seven segment LED's provide six variable digits plus an "M" and a decimal point. Information includes Shutter Speed, Aperture, Flash ready information,

Manual indication and flashing signals, in digital form. The display can be turned off when not needed without affecting the camera operation.

(7) Mirror Cut-off:

No mirror cut-off with telephoto lens as long as FD 400 mm lens.

(This is the same with AE-1.)

(8) Eyepiece Shutter: Built-in

(9) Accessories:

Angle Finder, Magnifier, Eyecup, and eyesight correction lenses.

(The same as for the AE-1.)

3.5 AE Function

(1) Method

Electronicly controled automatic exposure by setting the FD lens at the 'A' mark, and selecting the AE mode with the AT dial to relay the input of exposure control information.

(Three LSI with I^2L, one linear LSI,and one Bi-Mos IC, the latter for metering the light, are used.)

(2) Automatic exposure modes

AE Mode	Metering	Aperture Ring Setting of Lens	AE Mode Selector Switch	AT Dial Reading
Shutter speed priority	Full aperture	'A' mark	Tv	Shutter speed
Aperture stop priority	Full aperture	'A' mark	Av	Aperture stop
Programmed	Full aperture	'A' mark	Tv	P
AE flash	Full aperture	'A' mark	*Either Tv or Av	
Stopped-down	Stopped-down	Any aperture except 'A'	Either Tv or Av	

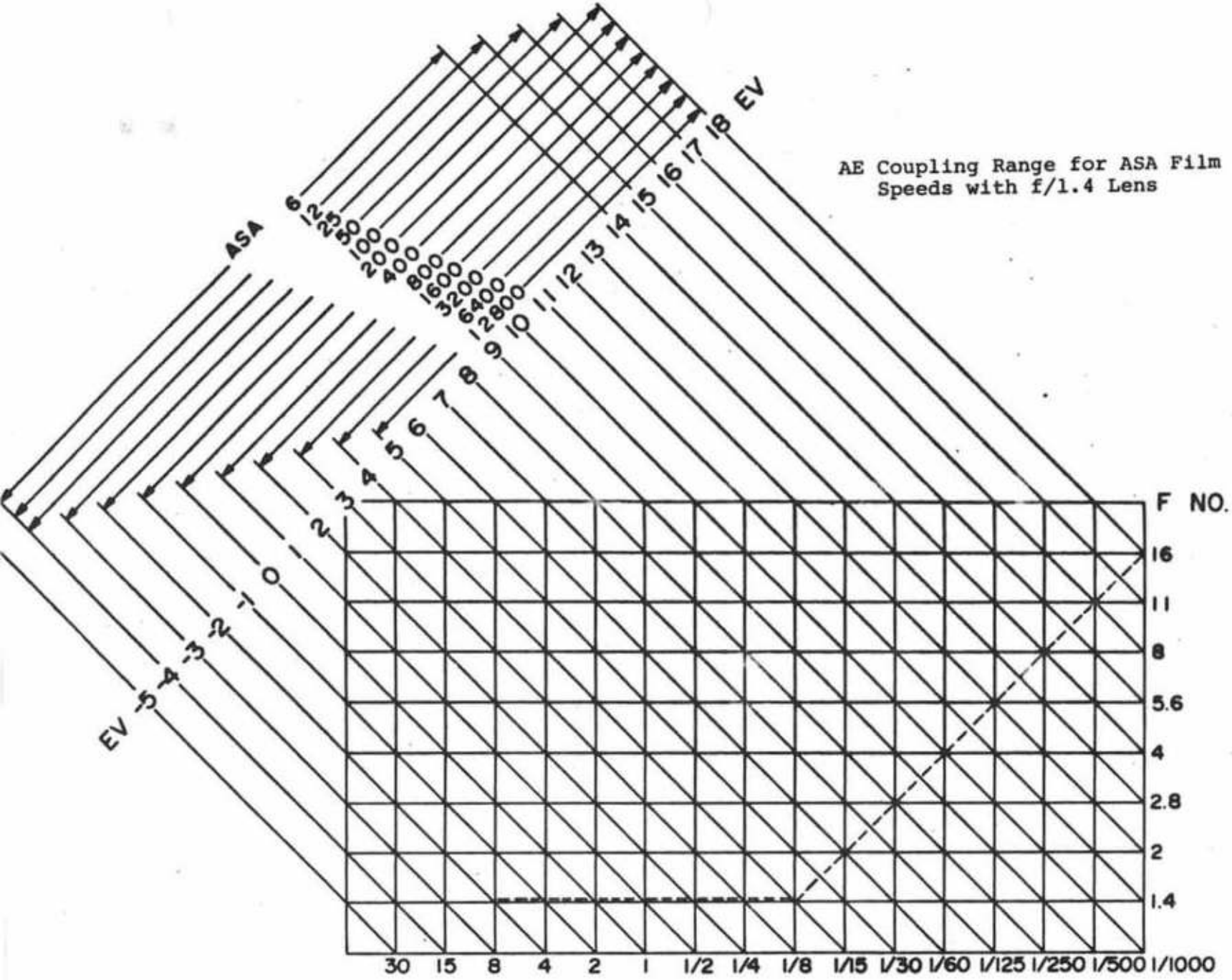
*: For a shutter speed of 1/60 or slower with the 199A, set the switch to Tv.

(3) Light Sensing Element

Center-weighted average meter reading (the same as the AE-1) by a silicon photocell placed above the eyepiece and fresnel lens to concentrate the incoming light.

(4) Meter Coupling Range

EV -2 (f/1.4 lens) to EV 18 with ASA 100 film. The programmed AE program is shown by the dotted line.


AE Coupling Range for ASA Film Speeds with f/1.4 Lens
ASA
6
12
25
50
100
200
400
800
1600
3200
6400
12800
EV
-5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
F NO.
16
11
8
5.6
4
2.8
2
1.4
30 15 8 4 2 1 1/2 1/4 1/8 1/15 1/30 1/60 1/125 1/250 1/500 1/1000

(5) Film Speed Range

ASA 6 to 12,800 in 1/3 step increments

(6) Exposure Compensation

Two full f/stop plus/minus control with figures from 1/4X to 4X and calibrations in 1/3 step increments. The following shows the range of exposure variations possible with the respective film speed setting:

ASA 6	1/4	. .	1/2	. .	1							
ASA 12	1/4	. .	1/2	. .	1	. .	2					
ASA 25 ~ 3200	1/4	. .	1/2	. .	1	. .	2	. .	4			
ASA 6400			1/2	. .	1	. .	2	. .	4			
ASA 12800					1	. .	2	. .	4			

(7) Exposure Memory

There is a memory lock button (located where the exposure compensation button is ON the AE-1). While this button is pressed, the exposure reading is locked and you are at your liberty to vary the combination of shutter speed and f/stop.

(8) Stopped-Down Metering Lever

The lever is of folding type and by lifting the end and pushing against the tension of the spring, it is locked in place.

(9) Other Operations

The AT dial has the following indications

AV	22	·	16	·	11	·	8	·	56	·	4	·	28	·	2	·	14	·

TV	P	1000	500	250	125	60	30	15	8	4	2	1	2	4	8	15	30	B

AV: Black figures in the yellow ground

P: Black in the green base

TV: 2" to 30": Yellow figures in a black ground

Other figures: White figures in a black ground

3.6 Power Source

(1) Battery

One 6V silver oxide battery (Eveready No. 544, UCAR No. 544, JIS 4G13, or Mallory PX28) or alkaline manganese battery (Eveready No. 537, UCAR No. 537) (This is the same with the AE-1.)

(2) Battery Chamber

Under the finger grip on the front of the camera body. (This is the same with the AE-1.)

(3) Main Switch:

By setting the shutter button lock lever to "L", all the electronic circuits will be turned off.

(4) Battery Check

True-load Type
The flashing frequency changes depending on the condition of the battery, roughly telling you how good it is. The slower the flashing frequency, the weaker the battery.

(5) Cancellation of the circuit

1) Set the shutter button lock lever to "L", or

2) Press the battery check button and take your finger off the button.

The AE-1's circuit is cancelled the moment the battery check button is pressed, while the A-1's circuit is cancelled the moment the finger is taken off the button. (To be more precise, the A-1's circuit is cancelled when the battery check button is pressed, but the battery checker current thru the second shutter magnets give the impression that the circuit is not cancelled.)

(6) Battery Life

The battery lasts for approximately 15,000 exposures or one year under normal use.

Normal use means that the camera is used with shutter speed at 1/125 sec and that the digital indications are lit for one second at every exposure.)

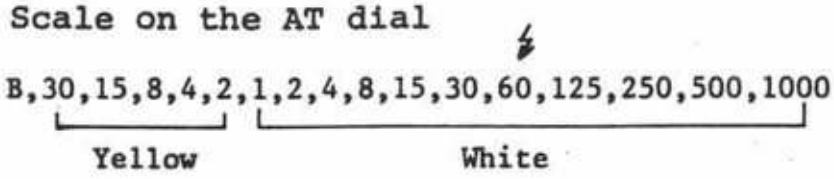
3.7 Shutter Mechanism

(1) Type

Dual roller type cloth focal plane shutter

(2) Speed

1) Scale on the AT dial



(3) Shutter release button

- Electromagnetic shutter release

  Large-sized shutter button is concentric with the AE mode selector.

(4) Synchronization contact

- X synchronization is at 1/60 sec.
- The accessory shoe on the top of the pentaprism has a direct flash contact. On the front of the camera body is a PC flash terminal, (JIS-B type). With built-in electric shock preventive rim.
- The accessory shoe has an automatic flash control contacts for automatically switching shutter speed and aperture.
- When using ordinary flash units (other than Speedlite 155A and 199A), set the AE mode selector to Tv and set the shutter speed to 1/60 sec or slower.

3.8 Self-Timer

(1) Type

Electronically controlled self-timer

(2) Operation

- Set the self-timer lever either to "2" or to "10".
- Activated by the shutter release button.

- The figures "2" and "10" mean that the self-timer releases the shutter after a time lag of two and 10 seconds respectively.

- Press the shutter button only after closing the eyepiece shutter, to block extraneous light. The camera measures the light the instant before shutter release. (The AE-1 measures before the self-timer starts).

- After completing self-timer photography, return the self-timer lever either to "A" or to "L".

(3) Cancelling the self-timer operation

- Return the self-timer lever to "L",

- Press the battery check button or set the dial at "B" and take your finger off the button.

(4) Self-timer operation indicator

A red LED beside the shutter button keeps flashing while the self-timer is in operation. When the self-timer lever is set to "10", the flashing frequency is 2 Hz until two seconds before shutter release and increases to 8 Hz after that time. When the self-timer lever is set to "2", the LED flashes at 8 Hz frequency.
This flashing helps the user to know approximately when the shutter will be released.

(5) Self-timer operation with the shutter button at "B"

If the self-timer is started with the shutter speed at "B", the camera will stop functioning the moment your finger is taken off the shutter button. This means that when the self-timer is in operation, it will be cancelled. Since the self-timer will not operate properly without a locking cable release when the shutter speed is set at "B", Canon has employed a safety device like that. (By using a locking cable release, the self-timer can be used at "B". Of course, manual exposure calculation is necessary).

3.9 Loading the Film

(1) Back cover

To open the back cover, pull up the film rewind crank. The camera's back cover has a memo holder. The back cover is interchangeable with the AE-1's back cover, and Data Back A.

(2) Film loading

- Easy film loading with multi-slot take-up spool.
- The film is wound around the spool in the counter-clockwise way.
  (This is the same with the AE-1.)

(3) Film advance lever

- Single stroke with 120° throw and 30° stand-off. The film can also be wound with several short-strokes.
- When the shutter is open, the film cannot be advanced.
- The film can be wound with the shutter button held in the depressed position. (These are the same with the AE-1.)

(4) Frame counter

Additive type. Automatically resets when the back cover is opened. While rewinding film, it counts backword. The frame counter does not advance during multiple exposures.

S·2·4·····18·20·22·····34·36·38

0, 20, and 36 are orange, other numbers are white.

(5) Film rewinding

Performed by using the rewind crank on the top. When the rewind button is pressed, it will be held in the depressed position and disengages the film from the film transport sprocket. The rewind button automatically resets by winding the film advance lever.

3.10 Multiple Exposures

(1) Operation

1) Press the multiple exposure lever towards the film advance lever.

2) Operate the film advance lever, and the film remains stationary and holds its exact position while cocking the shutter and charging the AE mechanism.

3) By operating the film advance lever, the multiple exposure lever automatically returns to its original position.

4) The frame counter does not advance.

5) Ratchet winding used for multiple exposures.

(2) Application

1) To perform multiple exposure

2) To reset the mechanism when the error mark "EEEE EE" is displayed in the viewfinder. The camera will not function even if the shutter button is pressed until the multiple exposure lever is pressed.

(3) Other points in multiple exposures

1) Multiple exposures cannot be performed when the Motor Drive MA or Power Winder A is in use on the A-1.

2) Once the multiple exposure lever is set, the camera will not function even if the shutter button is pressed.
When the viewfinder is showing the error mark, set the multiple exposure lever to put out the flashing for normal viewfinder display.

3.11 Camera Body

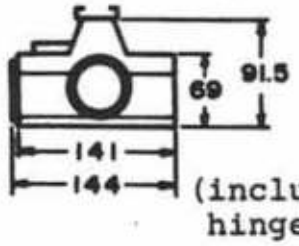
(1) Main Body: Aluminum die-cast body

(2) Upper cover and apron: Made of multi-layered metal plated plastic

(3) Tripod socket: Screw-in type (CU 1/4) in the center of the bottom

(4) Action grip: A large detachable type finger grip is available

3.12 Dimensions and Weight



(including hinges)

141 (W) x 91.5 (H) x 47.5 (D) mm

620g (body only, including a battery)

3.13 Related Accessories

(1) Standard*

- Accessory shoe cover
- Silver oxide battery
- Body cap R-F
- Eyecup 4S
- Neckstrap (with a shoulder pad)
- Adapter for tripod
- Action grip
- Semi Hard Case S or L

(2) Main system accessories

- FD lenses
- Motor Drive MA (new)
- Power Winder A
- Speedlite 199A (new)
- Speedlite 155A
- Data Back A

4. Main Features

4.1 Finder

Reversing the current trend to more and more complicated viewfinders with exposure information encroaching into the field of view from every direction, the A-1 viewfinder shows the field of view alone in a dark field. When the shutter button is pressed, the exposure information appears in neat digital form of red seven segment LEDs below the field of view if you wish to view it.

(1) Viewfinder Optical Design

A special optical plastic is used to make the prism which reflects the image of the LED's thru the penta-prism into the eyepiece. The LED's are located below the prism, well away from the SPC so they do not affect its reading.

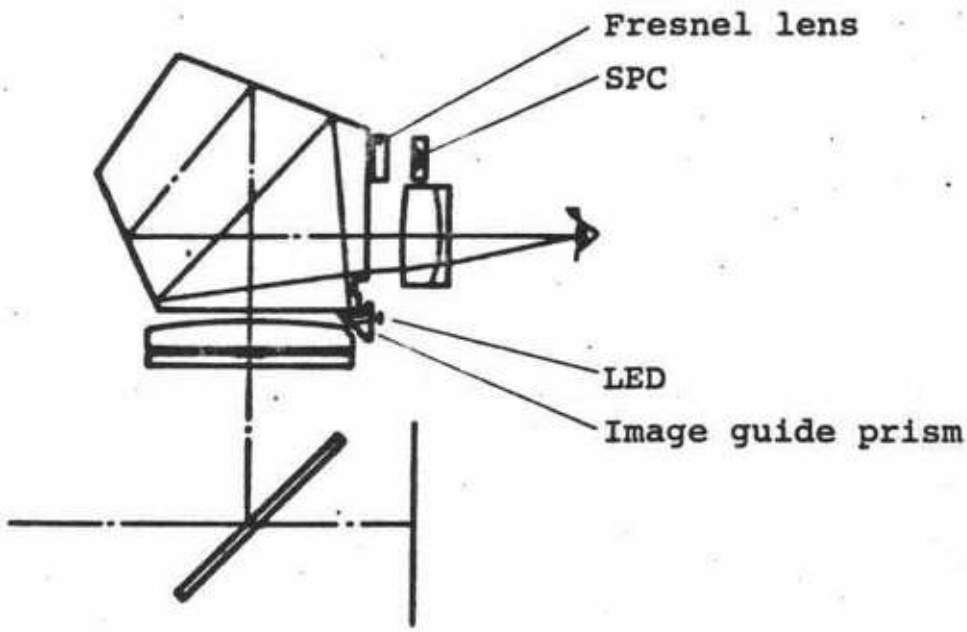


Fig. 1 Viewfinder Optics

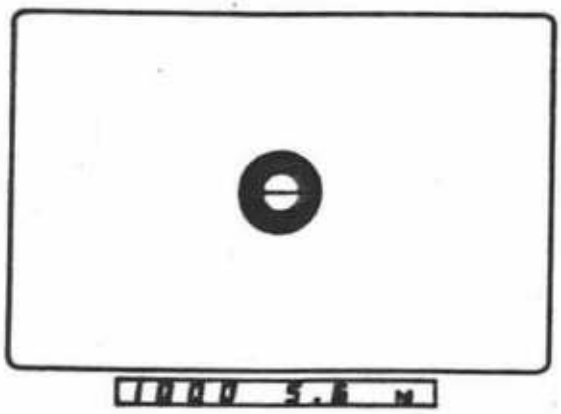


Fig. 2 Field of Vision for the Viewfinder

(2) Replacement of Focusing Screen

The standard outfit for the A-1 is the split-image microprism screen type. In addition, there are 6 types and the replacement of screen is possible at the authorized service facilities.

(3) Preventing the Ingress of Dust

Finder unit consists of a focusing screen, condenser lens, pentaprism, eyepiece lens, LED for display of information and light guide prism. As in the case of the AE-1, they are tightly sealed against the ingress of dust.

4.2 Viewfinder Information (character display viewfinder)

The viewfinder information of the A-1 includes the AE mode selected, pre-programmed and compated exposure values, warnings of incorrect exposures and improper settings for AE photography. These pieces of viewfinder information play a vital role in taking pictures.

This viewfinder is one of the main features of the A-1. We call it a character display viewfinder.

(1) Display position and method

Viewfinder information is displayed in the red LED's below the viewing area.

The display is designed so it is turned off when the viewfinder information is not necessary such as when

shutter is functioning or the self-timer is in operation. This saves the battery.

Some people find it easier to concentrate on composing the picture without the viewfinder information. A switch is provided so the display cam be turned off.

(2) Contents of the viewfinder display

1) Information format

The following display format is used in the viewfinder:

2) Information displayed

(a) Shutter speed

1/2 step increments from 1/1000 sec. to 30 sec. in 1/2 step increments, plus "B", maximum four digits. ("B" is displayed as buLb or bu.)

(b) Aperture

f/1.2 to f/32 in 1/2 step increments, two-digit display.

(c) The "F" letter display lights up when the flash unit (155A or 199A) is used and ready.

(d) The "M" letter lights to warn when the camera is not set for AE operation.

(e) When the tension of the aperture signal coupling lever of the camera is cancelled, the error mark lights up (six LEDs light up as EEEE EE).

If, after stopping down the lens by lens disengaging it from the "A" mark, the stop-down lever is released and the lens aperture ring returned directly to the "A" mark, the error mark will light up.

If this happens, the shutter button cannot be released and no further pictures can be taken.

Under the same situation for the AE-1 it is necessary to turn the aperture ring to the

maximum aperture before resetting it to the "A" mark.

The information (a), (b), (c), and (e) is displayed in seven segment LED's and (d) in a five-digital-segment LED*.

Numerals shown in 1/2 step increments are not always strictly exact ones and may be rounded off to familiar ones.

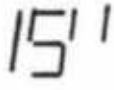
(Example)

An intermediate value between f/2 and f/2.8 is f/2.38 but it is displayed as f/2.5 (difference is 0.15 f/stops).

- Shutter speeds longer than 1 sec. are displayed with the second(") mark.

(Example)

1/15 sec. is displayed as

15 sec. is displayed as 

- Exposure is, as a matter of fact, controlled in 1/8 step increments. However, it would be troublesome to have these values display in the viewfinder as they would change so quickly depending on lighting conditions. Because it would be hardly possible to see a continuously changing shutter speed and aperture readout which are unfamiliar to users, we have done much testings about viewfinder information. After considering the physiological characteristics of human eyes, we have arrived at the conclusion that the signals of exposure should be transmitted to the display in 1/2 step increments.

This is why the A-1's viewfinder displays shutter speed and aperture values in 1/2 step increments as indicated below.

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*: The M has five segments itself. The decimal point in the aperture is electrically one segment of the M digit.

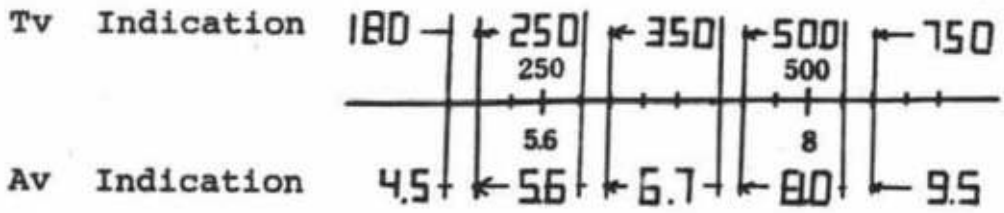


Fig. 3 Display Indication in 1/2 Step Increments

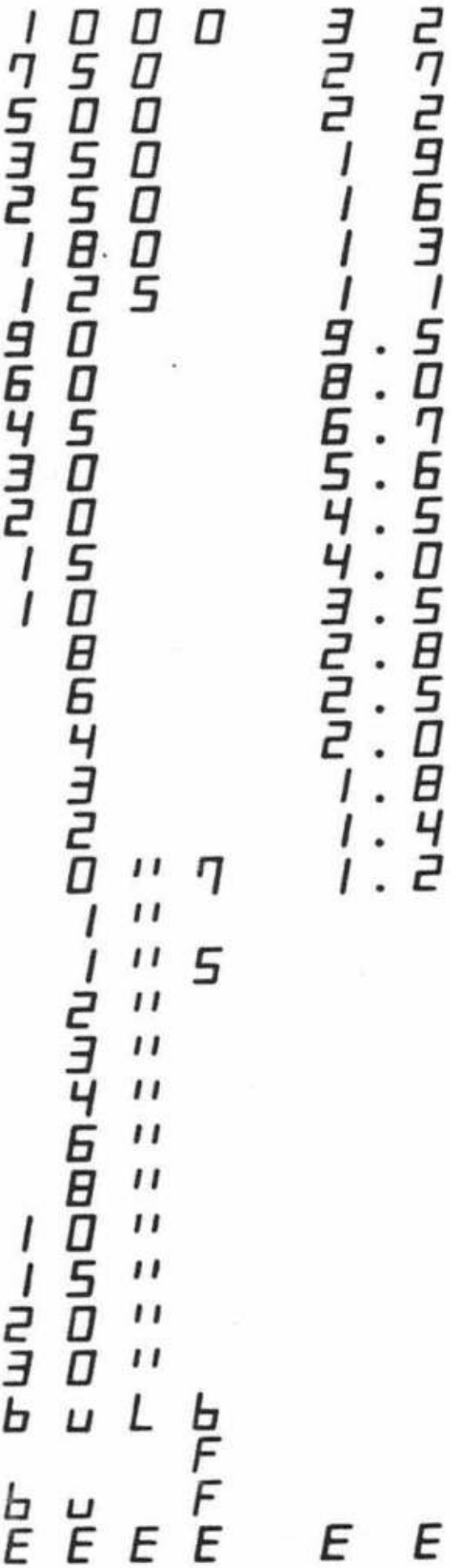


Fig. 4 Numerals and Characters to be Displayed

In fact, exposure is controlled in real time depending on variable lighting conditions. But, since the signal is transmitted to the display at every 0.6 sec, the data is displayed after a time lag of 0.5 sec.

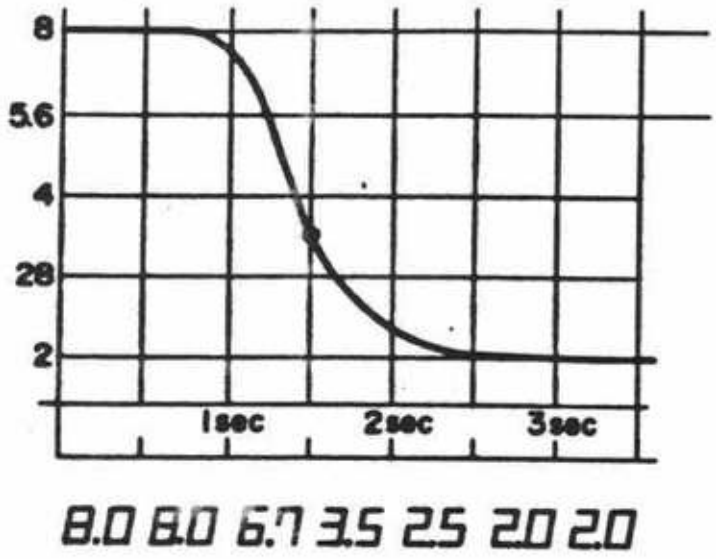


Fig. 5 Change in the Brightness of the Subject and Display

o Flashing is at 2 Hz

Summary

The display for each mode can be summarized as follows:

Camera Condition	Display Information	Flashing information
Shutter priority AE	TVS, AVC (AVO - 16)	AVO or 19,22,27,32 If brightness is too low (less than EV -2, ASA 100), both shutter speed and aperture flash.
Aperture priority AE	AVS, TVC (30" -1000)	30" or 1000 If brightness is too low (less than EV -2 ASA 100), both shutter speed and aperture flash.
Programmed AE	AVC (AVO - 16) TVC (X - 1000) X: Shutter speed which, combined with AVO of lens equals a brightness of EV -2 (ASA 100)	AV 16,19,22,27,32 } High brightness TV 1000 } TV: One step lower than X } Low brightness AV: AVO } (Both values flash together)
Stopped-down AE	TVC	A shutter speed which falls outside the meter coupling range (below EV -2, ASA100)
AE Flash (Speedlite)	60 F AVS 60 F AVS M 60 F M (Speedlite in manual) TVS appears when a slow shutter speed is used with the Speedlite 199A)	FD lens: AVO or 19,22,27,32 Other: 5.6 pr 19,22,27,32
Shutter speed set at "B"	buLb M bu F AVS bu F AVS M bu F AVS M (When the Speedlite is manual).	For an FD lens: AVO or 19,22,27,32 In other cases: 5.6 or 19,22,27,32
Error mark	EEEE EE	All six E,s

Explanation on the abbreviations used here:

TV: Shutter speed
AV: Aperture
S: Mode selection
c: Calculated value
AVO: Maximum aperture value of the lens used

o The degree of LED illumination changes in four step increments depending on the brightness of subjects seen in the viewfinder.

Brightness of subject seen in the Viewfinder	Brightness
Over EV15	1
From EV11 to EV15	1/2
From EV5 to EV11	1/8
Under EV5	1/16

In flash photography, when the charging completion signal is transmitted, the illumination is fixed at 1/8. (This is the degree of illumination designated for EV5 to EV11.) When the exposure memory switch is held in, the degree of illumination is determined by the lighting conditions at the time the button is pressed.

This explains why the LED brightness maintains almost the equal degree of illumination to human eyes even in the bright or dim light conditions.

(3) Point to remember

For shutter priority AE mode, there is a click stop for each shutter speed on the dial. If a shutter speed is set to an intermediate position between two adjacent shutter speeds, either of the two click stopping shutter speeds is indicated and the shutter is actually released at that indicated shutter speed.

(Example)

If a shutter speed is set to an intermediate position between 1/250 and 1/125, the shutter will be released at either of 1/250 or 1/125 sec.

Aperture value can be set for every half an f/stop in aperture priority AE mode.

In aperture priority AE mode, when the lens is set to an aperture value smaller than its maximum aperture AVO, the latter is indicated in the viewfinder and the exposure will be correct even if the shutter is released then.

(Example)

Using a 50mm f/1.8 lens, if the AT dial is set to f/1.2 or f/1.4, its AVO of 1.8 is indicated and

the shutter speed is determined automatically to respond to f/1.8 for correct exposure.

In aperture priority AE mode, it is impossible to set an aperture value of f/27 or f/32 since they are not on the dial.

If an aperture value smaller than the minimum aperture value of the lens used is set, exposure value corresponding to the set aperture value is displayed and the exposure will be over if the shutter button is pressed. (No warning in this case)

(Example)

Using a 50mm f/1.4 lens with minimum aperture of f/16, if the A/T dial is set to f/22, the viewfinder shows the exposure value calculated according to f/22 and the photo will be overexposed by one f/stop.

Both the scales of the film speed setting dial and those of the exposure compensation dial are calibrated for every 1/3 step increment while the display is calibrated in 1/2 step increments. If either dial is changed by 1/3 step, it occurs that the display remains the same or is changed by half a step. (Actual exposure is correct since actual exposure control is in 1/8 increments.)

"M" appears in the following cases:

a) Camera body and lens

a-1) When the lens is off "A" mark and is not stopped down

a-2) When the shutter speed is set to "B"

b) With a Speedlite in use

b-1) When the lens is off "A" mark

b-2) When the Speedlite is in manual mode

b-3) When the shutter speed is set to "B" (As an exception, "M" does not appear when both the lens and the Speedlite are in automatic mode even though the shutter speed were set to "B".)

b-4) When the stopped-down lever is pressed.

LED illumination

Since the camera memorizes not only the exposure value but also the light intensity of the LED display upon pressing the AE lock button, the display may be to dim to see easily when the camera is pointed to a bright subject after the exposure memory button is depressed with the camera pointed at a dark subject.

If either shutter speed or aperture value is changed while looking into the viewfinder, the indication seems to be late in responding to change of the AT dial. The reason is that a change of indication takes place after 0.5 sec. This is just a matter of indication and the exposure will be correct because the actual exposure control occures without time lag.

While metering the same subject, there is the case that there will be a difference of half a step in terms of exposure value when displayed if photographic mode changed between shutter priority, aperture priority or programmed AE mode. The reason is that the calculated value is displayed for every half a step in the case of shutter priority AE and aperture priority AE mode while in the programmed AE mode, both shutter speed and aperture value are both variable so the changeovers do not occure at exactly the same point. (There is no difference in the actual exposure.)

If AE photography mode is changed from one to another while metering the same subject, flashing warning may take place in the AE mode changed to.

(Example)

If an exact calculated value is 5.6 plus 1/8 though the viewfinder shows "1000 5.6" in the case of shutter priority AE mode, display changes to "1000 (flashing) 5.6" when changed to aperture priority AE mode. If the aperture value is set to f/5.6 in aperture priority AE mode under the same lighting conditions as above, the corresponding shutter speed will be calculated as 1/1000 plus 1/8 and in the case aperture priority AE mode, the display flashes if a calculated shutter speed is even slightly slower than 30 sec. or faster than 1/1000 sec. For the same reason, the display flashes if a calculated aperture value is smaller than the AVO of the lens used in shutter priority AE mode. The above happens only at a point near the limits of shutter speed (i.e. 30 sec. or 1/1000) in aperture priority AE mode and at a calculated aperture value larger than the AVO of

the lens used in shutter priority AE mode.

In Programmed AE, there is a case when the camera may warn of overexposure at the shutter speed/aperture combination for EV 18 (1/1000 sec./f/16).

This may not seem logical, as EV 18 is within the meter coupling range allowed for the camera. The reason for this is that the 1/1000 f/16 combination is supposed to be indicated in the viewfinder displays at exposure values up to EV 18 + 3/8. However, since the shutter speed indication of 1/1000 sec. is the fastest possible data in the viewfinder, the camera is made to indicate the overexposure flashing warning when the exposure requires a shutter speed faster than 1/1000 sec. Please refer to the following table for more details:

EV	Computation Value		Display Indication	
18	1/1000	16	1000	16
18 + 1/8	1/1000 + 1/8	16	1000	16
18 + 2/8	1/1000 + 1/8	16 + 1/8	1000	16
18 + 3/8	1/1000 + 2/8	16 + 1/8	1000	16
18 + 4/8	1/1000 + 2/8	16 + 2/8	1000	16

Accordingly, notice that when you are in programmed AE mode the viewfinder display flashing means that the camera is outside the exposure coupling range of EV 18.

While the self-timer is in operation or the shutter is open, the display goes out.

When an FD lens is used, full aperture metering and stopped-down metering may not have exactly the same display indication. This is because the shutter speed and aperture indication is displayed at every 0.5 step depending on such factors as the maximum aperture correction and f-number tolerances, linearity of the metering system. But, this poses no problem in actual exposure determination.

If the shutter button is pressed down in one quick stroke, the viewfinder display may not come on. (If the shutter button is held in the depressed position, the viewfinder display will become visible after the

shutter has closed.) To insure a stable viewfinder display, the viewfinder indication is supposed to display 60 to 80 mm second after the shutter button is depressed halfway. But, this gives rise to no delay in exposure determination.

To cancel the error mark in order to restore the camera for normal usage, set the multiple exposure lever, and wind the shutter.

When the multiple exposure lever is set, the error mark goes out and the camera shows correct exposure data in the viewfinder. But, the shutter button cannot be pressed until the film advance lever is operated.

When the viewfinder indicates the battery charge complation for the Speedlite 199A or 155A, the degree of the LED illumunation is constant regardless of the existing light level. In this situation, the LED illumination is the same as that which viewfinder shows when the light level in the viewfinder is in the EV 5 to EV 11 range. For this reason, the LED illumination for flash photography is not always the same as that for AE photography.

With the Speedlite 199A, if the shutter button is held in the depressed position, the "F" indication will not be displayed at flash charge completion because the camera ignores that signal, and remains in AE mode rather than switching to Flash AE.

Among the lenses which were manufactured before January, 1977, there are lenses with maximum apertures of f/1.8, f/2, f/2.5, f/3.5, and f/4.5.

In TV priority mode setting, the maximum aperture (AVO) warning may display a f Number 0.5 steps different than the actual aperture. With aperture priority mode setting, some of them may give a slightly different shutter speed information. With programmed AE mode setting, some of them may give a slightly different aperture information. This is because the aperture value will shift to an adjoining pattern depending on differences in the height of the lens speed adjustment pin. (However, there is practically no exposure errors.)

The FD 35-70mm f/2.8-3.5 S.S.C. lens has maximum apertures from f/2.8 to f/3.5 depending on the focal length. The height of the lens speed adjustment pin of this lens originally was determined based on the intermediate value of f/3.14, but now it is set to

f/2.8. Because of this revision, take notice of the following phenomena particular to this lens:

a) When you are in shutter speed priority mode, at the 70 mm focal length selection the viewfinder display flashes f/2.8 when the maximum aperture is actually f/3.5.

   When you are in aperture priority mode, at the 70 mm focal length selection, the viewfinder display indicates f/2.8 instead of f/3.5 when set to the maximum aperture. (New lens; old lens may show either f/2.8 or f/3.5)

b) When you are in shutter speed priority mode, at the 35 mm focal length selection, the viewfinder display flashes f/3.5 when the aperture is set to f/2.8.

   When you are in aperture priority mode, at the 35 mm focal length selection, the viewfinder display may indicate f/3.5 when the aperture is preset to f/2.8. (old lens)

c) When you are in programmed AE mode, at maximum aperture (AVO) the aperture is fixed and the shutter speed becomes variable. But, in this case, the aperture value shifts a little bit, also.

Combination use with the Motor Drive MA

With the "high" mode setting, the viewfinder display is not visable.

With the "low" mode setting, the viewfinder display is visible, but the flashing warnings cannot be seen.

However, depending on the battery consumption in the Motor Drive MA the winding speed is not always the same and, accordingly, the above description may not be true at all times.

4.3 Camera Controls

(1) Control Block Diagram

All data received such as film speed, exposure method (shutter speed in case of TV setting; f/stop value in case of AV setting; P setting in case of programmed exposure), maximum f/stop value of the lens in use,

maximum aperture correction for lenses brighter than f/2.8, self-timer setting, and the use of stopped-down metering lever, registers with a digital switch. Only light metering is in the analog form and analog-to-digital converter is used to generate digital signals.

The micro-computer receives all digital information while signals which come out from the analog-to-digital converter are loaded to the micro-computer after going through the input bus line. Then the micro-computer perform arithmetic operations on the signals. In the A-1, the micro-computer first stores the exposure value (EV) and then does the arithmetic operation. The merit of the new system is that with the A-1, the exposure value (EV) is stored by pressing the exposure memory button so the camera user is at liberty to change the combination of ASA film speed setting, shutter speed and aperture opening.

The result of the computed value is decoded by the decoder driver after going through the output busline, before the exposure information appears in the viewfinder in the form of seven-segmented glowing red LED display. On the other hand, the program storage contains the instructions for the operational sequence and performs the function of procedure and control of the exposure mode selector such as shutter speed priority AE, aperture priority AE, and programmed AE. The existence of the program unit with the programmable logic array makes possible the input of information in the fashion of a single-lever-and-dial movement. The capability of this data-loading program is evidenced by the placement of the entirely innovative AE mode selector and AT dial stop the camera.

As you press the shutter-release button, the magnetic release is activated and while the automatic aperture control of the FD lens activates, automatic exposure mechanism coupled to the lens aperture signal pin commences to function and then the precious metal wire brush wipes over the segmented aperture value electrode (SAVE) plate at high speed. Automatic exposure aperture setting is determined when the countdown of pulses and the f/stop control functions generated by the CPU coincide. While the proper f/stop value is taken care of, shutter control activated by the digital switch accurately converts the signals to specific shutter speeds in a digital way by a reading made within the computer. Thus after a duration of a designated time following the travel of the first curtain, the CPU sends a signal to the Magnet 3 to close the second curtain.

Fig. 6 CANON A-1 FUNCTIONAL BLOCK DIAGRAM

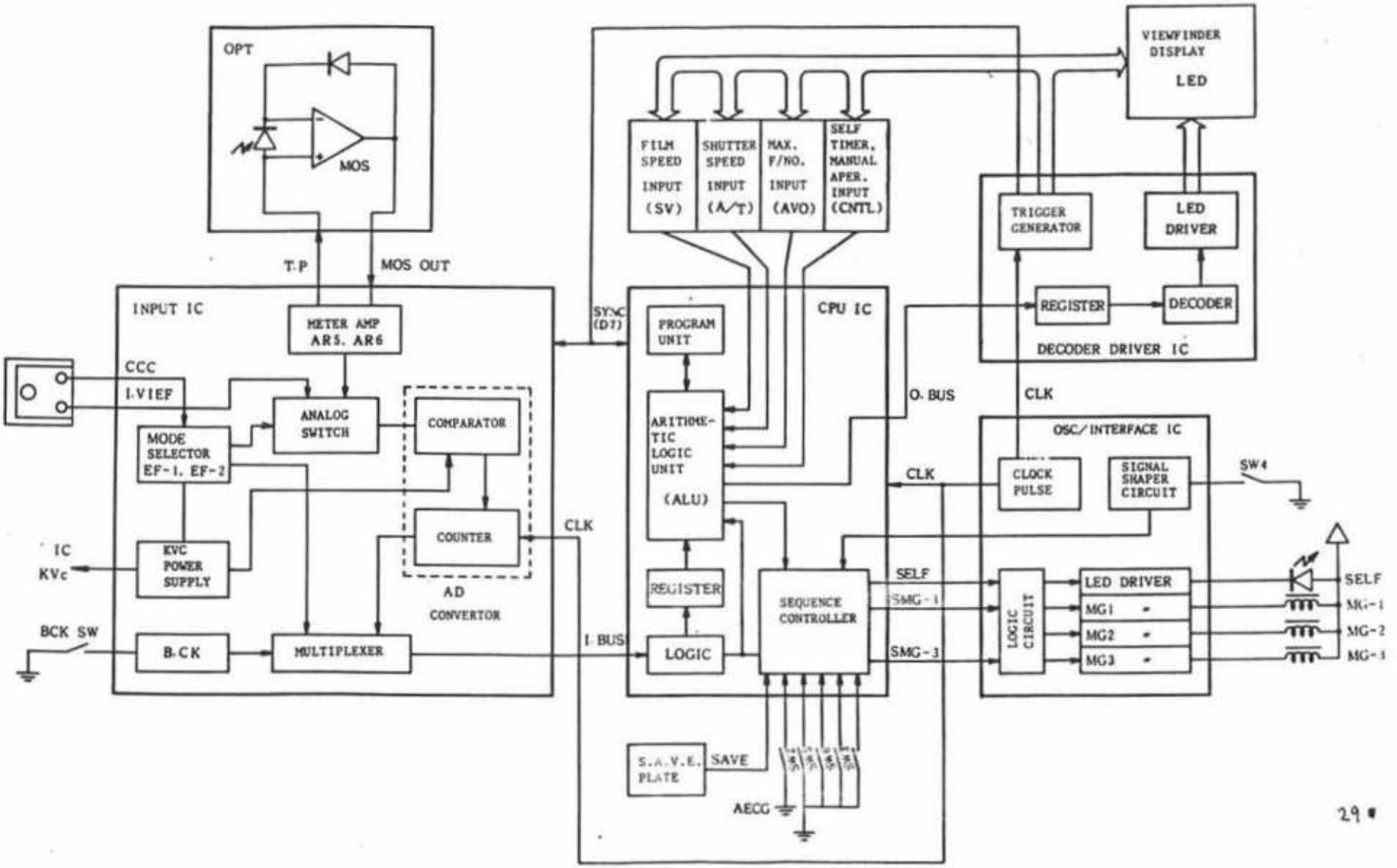
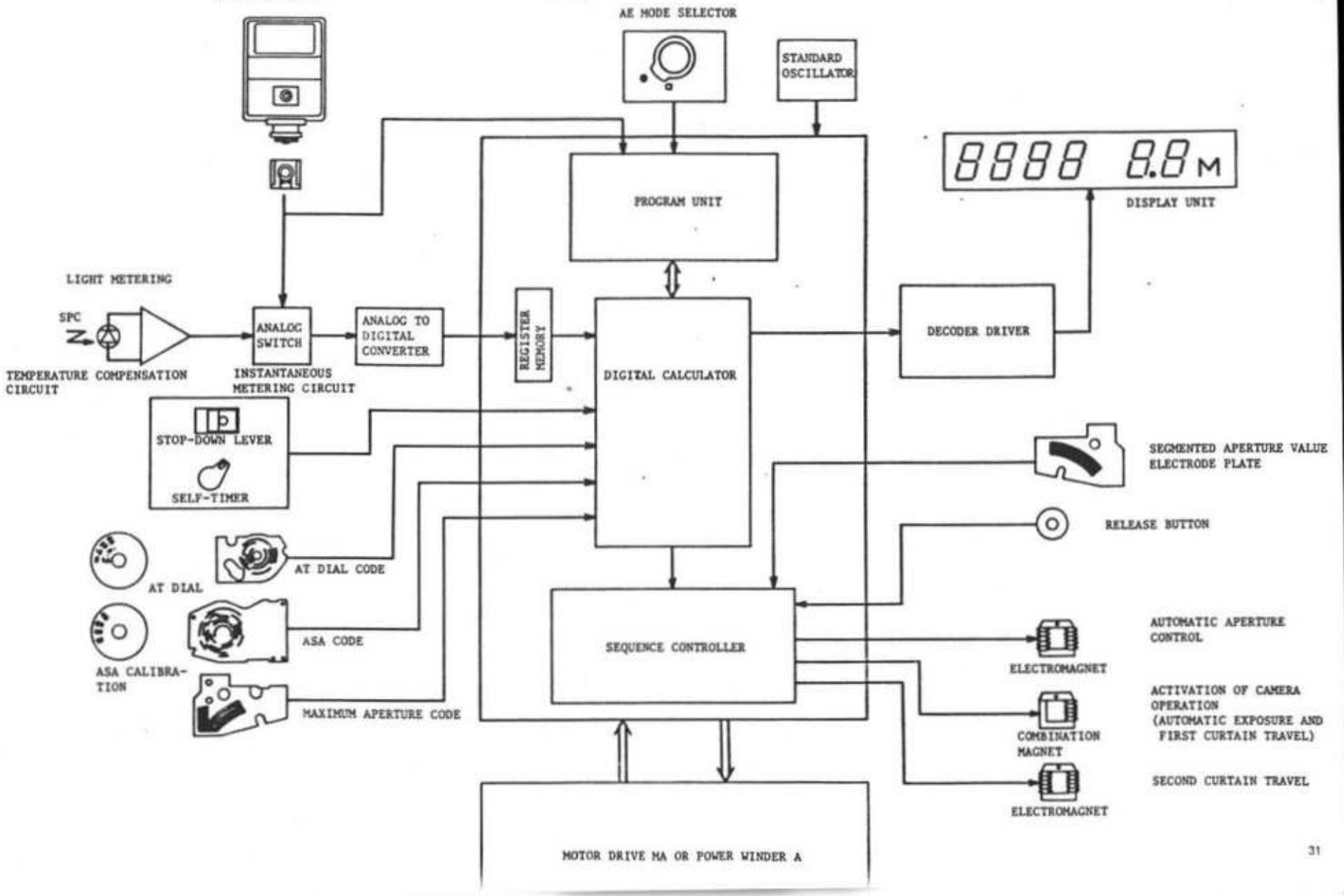


Fig. 6 2 BLOCK DIAGRAM OF COMPUTER INTEGRATED INTO NTROL SYSTEM



(2) Digital Control

The A-1's camera controls (input, memory, computation and control) are all taken care of by digital signals. Digital systems have following features compared to the analog systems.

As controls for the desired operations are carried out by digital signals (combination of on-off switches) instead of by analog values, there is no unfavorable results from changes in temperature and humidity, no wearing out of the parts such as resistors, and no deterioration from age. This means upgrading of quality and improved performance reliability.

The employment of the digital system instead of the analog system results in lower manufacturing cost, and more compact design. (Versatile functions due to greater circuit density in the compact body.)

The infusion of solid-state technology for the display of information resulted in improved durability against vibration, shock and environmental change, and thus greater reliability.

Great increase in the amount of information that can be displayed and information that can be read with far greater accuracy.

Reduction in the total number of parts and component parts requiring adjustments. Quite a few parts can be put into the form of monolithic IC chip and this means lesser need to, as additional process, solder parts such as resistors and capacitors. Credibility in performance and cost reduction are thus realized.

Through digital control of automatic exposure and shutter speed, repeatability is improved. It means greater overall accuracy.

Incidentally, in some aspects digital systems are looked upon unfavorably compared to the analog system. For example, digital response is not stepless. The A-1's digital system is an 8-bit unit which means a capability to control shutter speed and f/stop values in 1/8 step increments. (Yet in accuracy there is an improvement over the previous analog control.) And in readouts fresh information is fed every 0.5 second and information display appears in 0.5 step increments. This 0.5 value was established from the reasons of easier viewing of displays and familiarity with the values displayed. It is possible to display in-between

values but the values will not be completely stepless as in the case of analog system.

(3) Circuit Component

One IC and four LSI are used in the A-1's electronic circuit.

OPT IC:

The MOS-BI log amplifier is integrated with the SPC and sealed into a single IC. The IC used in the A-1 has a wider metering range than the one in the AE-1.

INPUT IC:

This is an I^2L with an internal layer insulation. It is used in the area of information input. This is part of the LSI design where analog and digital circuit are on the same chip as isolated I^2L, and includes the AD converter.

CPU IC:

This is an LSI consisting of pure I^2L and including the CPU. As this LSI is composed of digital circuits, only greater circuit density is achieved. As insulation between analog and digital circuits is not necessary, density can be increased proportionally.

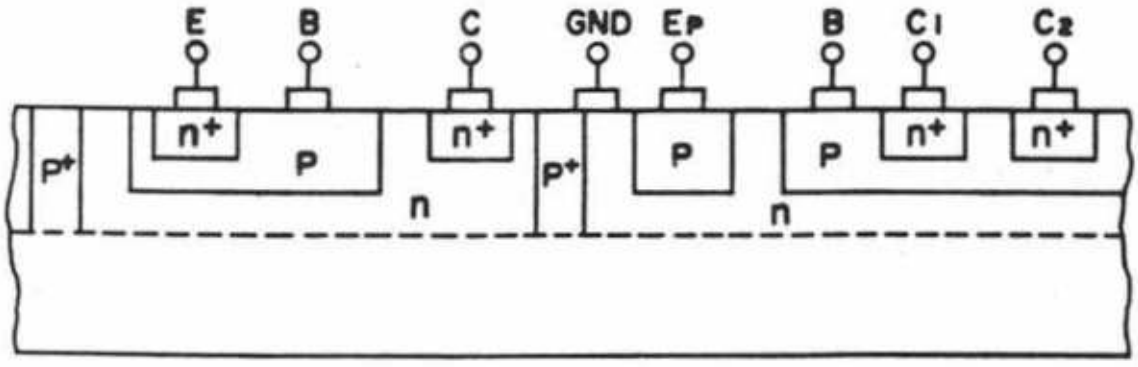
In the LSI of the A-1, an 8-bit micro-computer is built-in. Fig. 8 shows the construction of the pure I^2L.

OSC/INTERFACE:

This is a bi-polar IC consisting of oscillator and interface circuits. In this section, high stability oscillator, a magnet which activates at a constant current, and driver to activate the LED are built in.

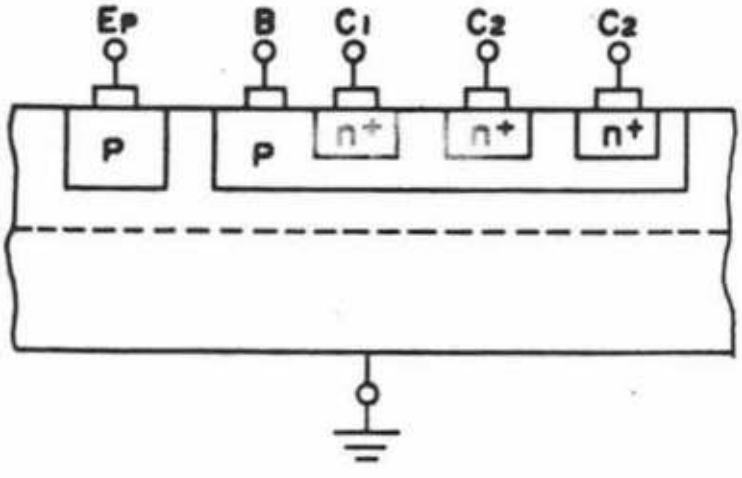
DECODER DRIVER:

This IC is an LSI of I^2L (isolated I^2L) with internal insulated layer used in the decoder driver section. Here too, a constant current LED driver is built in to give advantage of reduction in the number of parts and savings in the consumption of electricity.



Analog circuit Digital circuit

isolated I^2L



pure I^2L

E. Ep: Emitter
B: Base
C.C_1.C_2: Collector
GND: Ground (Earth)

Fig. 8 Comparison between the Isolated I^2L and Pure I^2L

4.4 Electronic Circuit Characteristics

(1) Light Metering

For a light-sensing element (as in the case of the AE-1), an SPC which excels in linearity and quick response is used. The SPC's dynamic range has been put into practical use and the A-1 is capable of automatic exposure over a 21 EV range (EV -2 to 18). Furthermore, stabilized performance is possible because of provisions provided against exposures to environmental change. The logarithmic amplifier (Bi-Mos construction) and discharge circuit (to enable better signal response) are assimilated into the IC, and the SPC and IC are sealed into a single package, immune to humidity and thermal changes.

The SPC is positioned above the eyepiece as in the case of the AE-1. The employment of a fresnel lens to concentrate the light means mounting the A-1 with different lenses affects consistency in center-weighted average meter reading very little.

The sensitivity distribution pattern for the A-1 is slightly, but not appreciably different from the pattern for the meter reading of the AE-1.

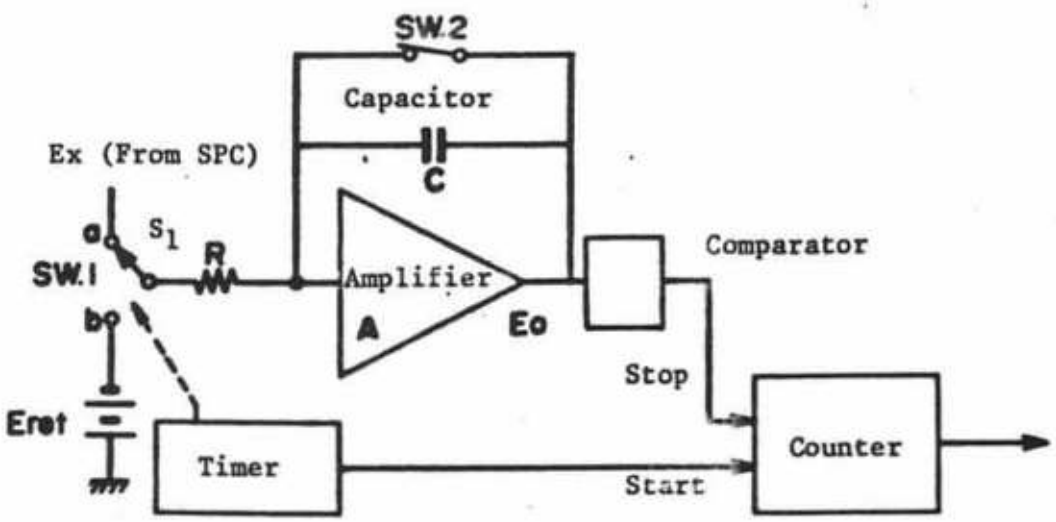


Fig. 9 Block Diagram for Dual Ramp Analog to Digital Converter

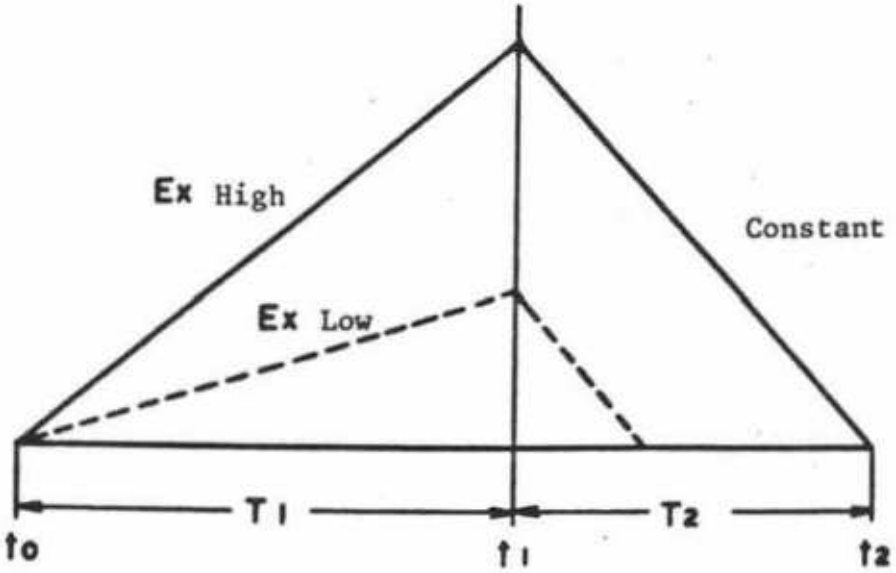


Fig. 10 Timing Chart for the Dual Ramp AD Converter

(2) Dual Ramp Integration Analog-Digital Converter

The analog information on brightness sensed by SPC must be converted into digital signal. The A-1 incorporates a dual ramp integration analog-digital converter.

Let us describe principles of the dual ramp integration analog-digital converter (Fig. 9). Ex is a pre-metered voltage from SPC which is connected with the "a" terminal of the switch S_1. When the switch S_2, starting at the time "T_0", is turned off, Ex is introduced into the integration circuit which consists of the registor "R", the capacitor "C", and the amplifier "A" and is integrated for a fixed time "T_1". The output voltage "E_0" at this time can be obtained as follows:

$$E_o = \frac{1}{CR} \int_{t_o}^{t_1} Ex\,dt = \frac{T_1}{CR} Ex$$

The timer generates the voltage which is proportionate to the input voltage Ex and the integration time T_1. This timer is controlled to integrated for the fixed time (T_1) of 10mS. This means that the final value of E_0 changes according to Ex only. Turning the timer's switch to the "b" at the time "t_1" after a lapse of the time "T_1", Ex and a given voltage Eref.

with an opposite polarity are sent to the integration circuit. The output of the integrator is integrated with the opposite porarity, and it will serve to decrease the integrated output voltage "E_0". See figure 10*

As Eref. remains fixed regardless of the amount of Ex., the intergrated values have a constant slope at all times. As a result of the intergration, E_0 will become zero (t2), and at this time the comparator which is connected with the integrator detects the zero voltage and generates the signal.

$$E_0 = \frac{T_1}{CR} Ex + \frac{T_2}{CR} (-Eref) = 0$$

$$\frac{T_1}{CR} Ex = \frac{T_2}{CR} Eref \qquad \therefore T_2 = \frac{T_1}{Eref} Ex = KEx$$

As the above formulas obviously tell you, T_2 is exactly proportionate to the input voltage. Namely, the "T_2" is a lapse of time from t_1 to t_2 and that corresponds to the brightness of the subject. The counter counts pulses of the T_2 and gives the digital number in exact proportion to the metered amount of light. After going through this cycle, the switch "S_1" again returns to "a", turning on the switches "S_2" on both sides of the condenser in order to reset the cycle and start metering the voltage.

This system has the following advantages:

A) There is no need to take into account variations in capacitors and registors. The amount once stored into the capacitor is discharged through the same resistance as when being charged. As we can only pay attention to the time it takes, there is no worrying about variations in capacitors or changes in temperature and humidity, or deformations of parts that may occur with aging.

B) Flicker Prevention of the Light

Fluorescent lamps and those which lights up through AC power source has, without exception, waves particular to the AC power source. When immediate-response elements or displays are used, there will be a difference in metered data between the upper end and the lower end. This

---

*: This figure is inverted when observed on an oscilloscope.

difference leads to an error.

The A-1 is equipped with a device to prevent variations due to A.C. flicker.

c) A high degree of noise-resistance

About 80 to 90 percent of digital voltmeters employ the dual ramp integration analog-digital converter.

(3) Input Information

With the exception of brightness, photographic information such as shutter speed, aperture, ASA film speed are all input in the form of digital numerals by the digital switch composed of a code plate and a precious metal brush. The digital switch needs four to six bits and in order to incorporate these bits in a limited space, the most primary concern is to reduce the interval between conductors. (The AV/TV information switch has an interval of 0.15 mm between conductors and a conductor width of 0.15 mm. This is the limit of present technology.)

Erroneous information must not be input when the wire brush moves somewhere between click-stops. Otherwise the precision of the camera will be jeopardized.

The A-1 employs a Gray code (or a cyclic binary code) instead of a natural binary code. Let us mention the difference between these two codes. The ordinary type of natural binary code has 2" as its base. (As the signal is transmitted by the switch being turned on/off, everything is processed by the binary code.) Supposing the code has three bits, the natural binary code will be as follows:

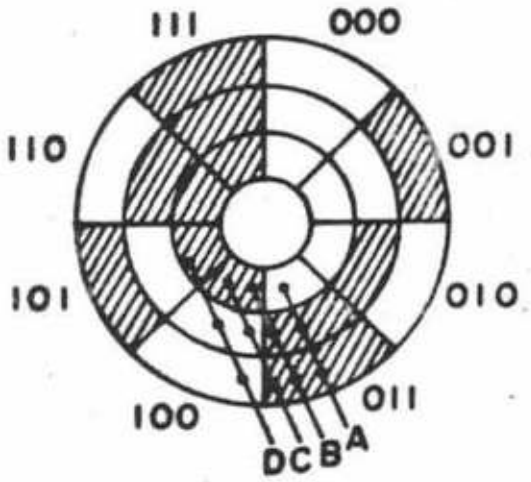
1 $0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 001$

2 $0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 010$

3 $0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 011$

4 $1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0 = 100$

The problem arises between 3 and 4. (The diagram is idealized to facilitate your understanding.)



A will be 011 = 3

B will be 111 = 7

C will be 101 = 5

D will be 100 = 4

Fig. 11 Detection of Cords

Depending on the movements of the wire brush, this would lead to a completely wrong value. The gray code was invented to surmount this type of obstacle. The switchover of adjoining code is only one and, therefore, even when the wire brush moves on the boundary of code, only either one of code will be inputted, the effective one will appear in the viewfinder display. Please notice that signals inputted by the Gray code will be decoded into the natural binary code in the CPU circuit. Therefore, the Gray code assure error-proof function.

	Natural Binary Code	Gray Code
0	000	000
1	001	001
2	010	011
3	011	010
4	100	110
5	101	111
6	110	101
7	111	100

(4) Digital Computation and Codes

Computation is carried out in the arithmetic logic unit (ALU for short) inside a micro computer based on the information given by the input mechanism. All data are processed in the form of digital numerals. This camera is unique in that all the data processing such as data input by the Gray code and computation are done by codes. No other camera has had such data processing and computation system.

Data is processed by 8 bits and we are introducing some of them below. The 8 bits enable you to make a code of $2^8 = 256$. Notice that these data are processed in CPU by means of natural binary code*.

	MSD LSD
ASA 100	00100000
ASA 400	00110000
Shutter speed 1/250	10001000
Shutter speed 1/500	10010000
Aperture f/4	00101000
Aperture f/5.6	00110000
EV value EV 10	10100000
EV value EV 11	10101000

*: Code tables in the Repair Guide are written with the least significant digit (LSD) at the left for ease of use with test equipment.

Based on these data, computation, in addition and subtraction of data takes place very rapidly in CPU through the APEX system. This helps determine correct exposure. The APEX system computes data through addition and subtraction with the applied logarithm.

The basic APEX formula is:

$$EV = TV + AV = BV + SV$$

For your reference, the conventional computation system is carried out through multiplication, division and square.

$$2^{EV} = \frac{A^2}{T} = \frac{BS}{K}$$

Ev --- exposure value

A ---- f-number

T ---- shutter speed

B ---- brightness of the subject

S ---- film speed

K ---- constant

For a detail discussion of the APEX system, refer to the General section of the AE-1 Repair Manual.

(5) Display Information

Computed results such as shutter speed, aperture and other information required for determining exposure are all displayed in red LED's through the decoder driver. The viewfinder information is displayed in the dynamic display method which is helpful in reducing the number of wires and power consumption, and cutting cost. See the figure 13. (a) describes the static display method, (b) shows the principles of the dynamic display method, and (c) shows the timing chart.

In the static display method, the counter output is input into the decoder driver by means of four lines. After being decoded for a seven-segment LED display, signals are transmitted into the seven-segment LED display by means of seven lines. This means that the static display method needs the same number of counters and decoders as it has display digits. The necessary number of wires amounts to the digit number multiplied by seven.

On the other hand, the dynamic display method requires only one decoder driver through one multiplexer without regard to the number of digits. The wiring simply requires for seven lines to be connected. As far as the display is concerned, each digit should be provided with the ground line and transistor switch.

In this way, each digit of the display lights up by means of time control at the cycle of the multiplexer and display. In the diagram (c), the clock pulse oscillates at a higher frequency, than the display has the repetition of on and off as shown in T_1, T_2, T_3. Because of an afterimage effect, the display which flashes on and off at a high rate gives the impression that the display is glowing steadily. One digit of the display is lit for 15μS and 240μS is alloted for one complete lighting cycle. Therefore the duty cycle is 15/240 = 1/16. The characteristics of the LED is that it has higher efficiency when flashing, on and off than when lit constantly. And flashing LEDs save power consumption and yet the visibility is very good due to the higher power of illumination. The flashing power and cycle were determined after making many lots of monitoring experiments.

In this fashion, the wire of the display will do with the number of digits multiplied by seven and with only one decoder driver. This contributes to the cost effective reliability and power-saving while taking into consideration the characteristics of the human eye.

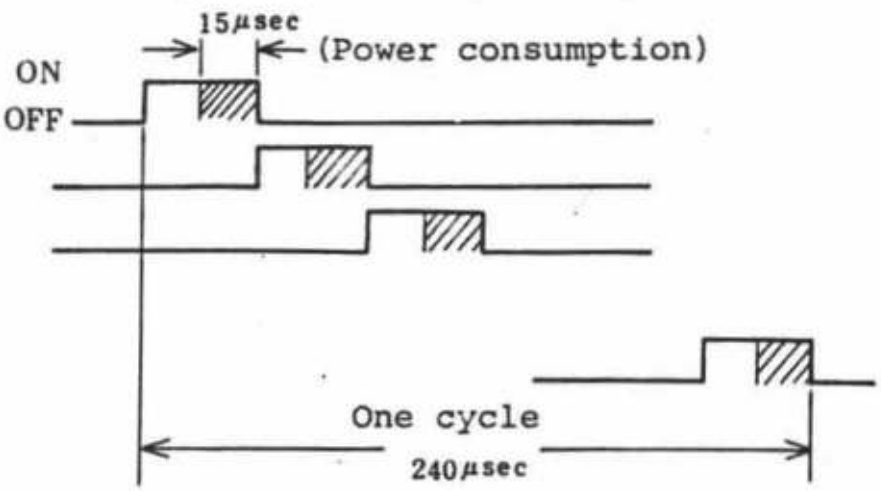
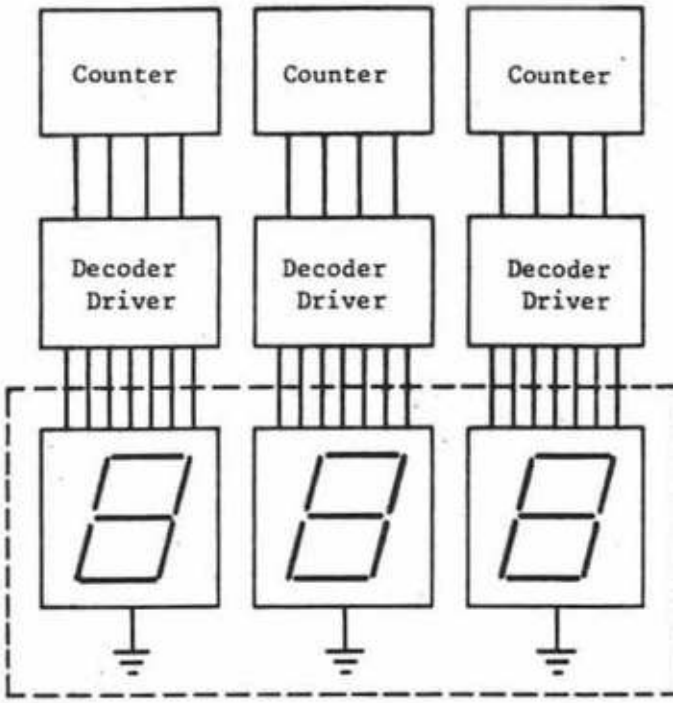


Fig. 12 Filming Chart of Lighting

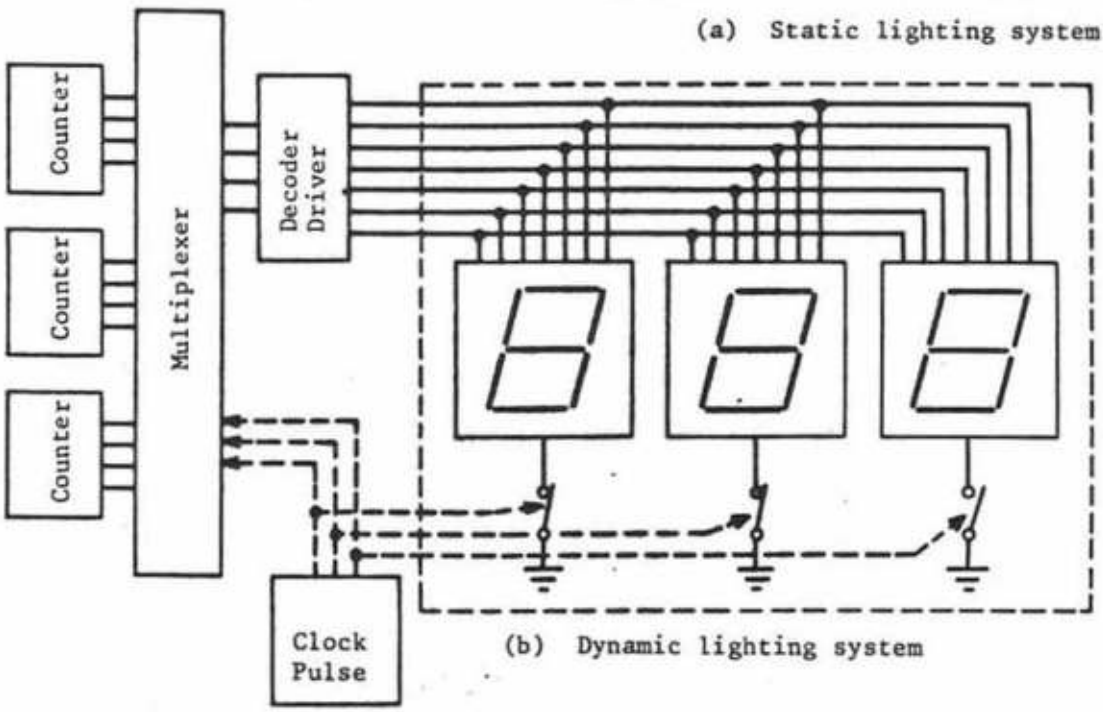
Computed value is output from the processer in the form of the BCD (Binary Coded Decimal) code. Since the display system employs a seven-segment LED (five-segment LED for "M" display or six segments including the decimal point for aperture indication. One segment is not wired.), the BCD code cannot be directly turned into the seven-segment LED indication without any aid existing in-between.

In order to make corresponding connections between those two different information, a circuit which decodes the BCD code into seven segments and makes the LED flash is required. This is the main role of the decoder driver and the relation between the BCD code and seven segments is shown in the chart to facilitate your understanding.

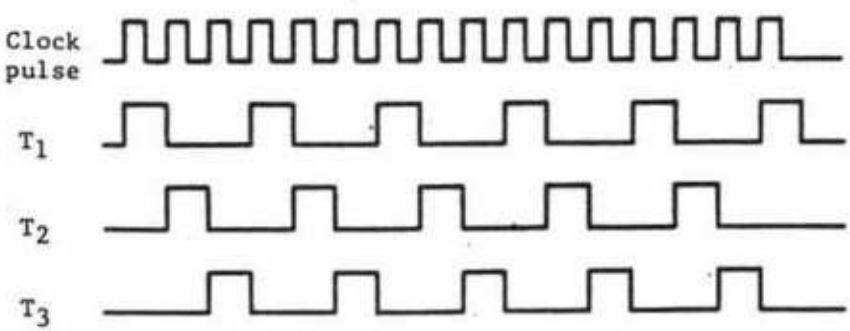
Fig. 13 Static and Dynamic Display System



(a) Static lighting system

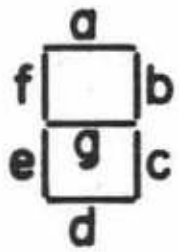


(b) Dynamic lighting system



(c) Timing chart

Dis-play	B C D (Binary code)	Seven-segmented LED a b c d e f g	
0	0 0 0 0	1 1 1 1 1 1 0	0
1	0 0 0 1	0 1 1 0 0 0 0	1
2	0 0 1 0	1 1 0 1 1 0 1	2
3	0 0 1 1	1 1 1 1 0 0 1	3
4	0 1 0 0	0 1 1 0 0 1 1	4
5	0 1 0 1	1 0 1 1 0 1 1	5
6	0 1 1 0	1 0 1 1 1 1 1	6
7	0 1 1 1	1 1 1 0 0 1 0	7
8	1 0 0 0	1 1 1 1 1 1 1	8
9	1 0 0 1	1 1 1 1 0 1 1	9
b	1 0 1 0	0 0 1 1 1 1 1	b
u	1 0 1 1	0 0 1 1 1 0 0	u
L	1 1 0 0	0 0 0 1 1 1 0	L
F	1 1 0 1	1 0 0 0 1 1 1	F



Seven Segmented Code, Codes have been rewritten here for easier understanding in this chart and they do not correspond to the codes actually used in the A-1).

(6) Memory

Since the A-1 employs a method of digital memory as in the AE-1, the data once memorized never leaks due to changes in temperatures and switchless, stable and highly accurate storage is assured.
This is a very convenient way in the point that the brightness of the subject is stored after being converted to the digital form. An eight-bit register is built into the memory circuit and memorizes the digital value.

(7) Count Down Chain

The A-1 has incorporated a frequency divider composed of a 20-step flip-flop circuit which is capable of counting down the basic frequency of 32 kHz to a maximum of 32 sec. Various kinds of time control are possible by combining different frequencies in between those two extreme values.

Some practical examples are: 1/1000 ~ 30 sec (32 sec)

Self-timer: 2 and 10 seconds.

The LED flashes on and off in 2 Hz for the first 8 seconds and in 8 Hz for the last 2 seconds prior to the shutter release.

Viewfinder Displays

Flashing LED for warnings (2 Hz)

Entry of new information (at every 0.5 second)

Controlled time during which the electric current is applied to various magnets.

Anticipated time within which the mirror completely returns to its original position when shooting continuously by means of the motor drive. Namely, the time required from the start of the second shutter curtain's travel till the mirror's complete return to the former position. (Approximately 112 milliseconds)

(8) Program Unit and Sequensor (PLA)

The A-1 has incorporated a program unit consisting of an versitile logical element called a (Programmable Logic Array) or PLA for short. This program unit contains programmed sequences of execution which respectively corresponds to each selective AE mode

and makes AE photography possible by controlling the camera's exposure computation system according to the computed values obtained by the corresponding programmed sequence.

The A-1 has many functions full of possibilities.

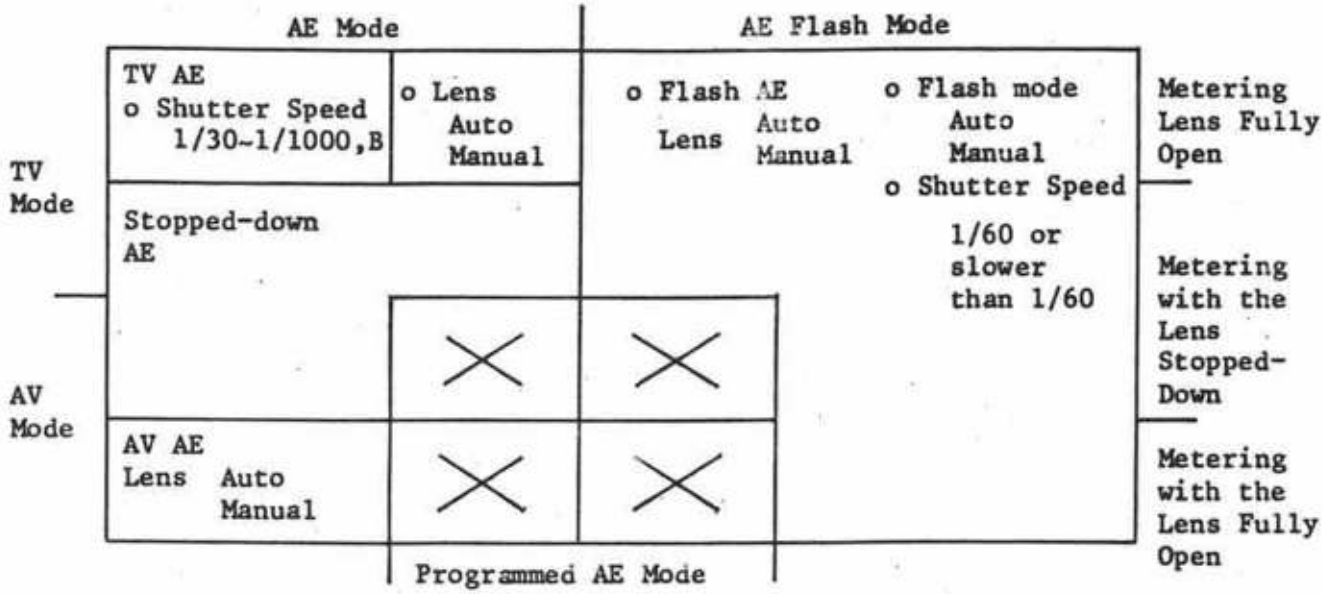


Fig. 14 PLA of the A-1

As explained above, the A-1 enables the photographer to use it in many ways owing to the built-in PLA which is capable of detecting which AE photography mode has been chosen and controlling the camera operation by means of the program designated. (Figure 10)

(9) Bus Line System

The A-1 has employed the bus line system for its data transmission. To put it simply, the bus line is divided into two main lines. One is for input of data into the CPU after subject brightness has been converted into the digital form and the other one is for transmitting the computed values from the CPU to the decoder driver.

The former is called "I bus (Input bus)" and the latter "0 bus (Output bus)". The bus line system is also made use of when the following listed information

is input into the CPU by way of the switch based on the Gray Code and information switches.

1) Preselected value in either the shutter speed priority (TV) or aperture priority (AV) AE mode.

2) Film Speed (SV)

3) Lens maximum aperture (AVO + AVC)

4) Self-timer setting

5) Information of whether the lens is stopped down or set for manual or automatic control

The bus line system used for the A-1 is based on the time sharing system in which a great deal of information is transmitted through a few lines and is considered the method best suited for a small-sized aparatus like a camera.

Taking an example of its functions, analog information of the subject brightness metered by the A-1 is converted into 8-bit (one word) digital information and is expressed to the minimum unit of 1/8BV. Eight lines are necessary to get eight-bit signals transmitted at the same time to the micro-computer for computation. In other words, each bit of the eight bits is ranked in the order of 1/8BV, 1/4BV, 1/2BV, 1BV, 2BV, 4BV, 8BV and 16BV.

Taking the case of the signal "01001100" for example, the resulting digital information of the subject brightness becomes 6.25BV (1/4 + 2 + 4 = 6.25BV). This information is input into the micro-computer to be computed together with other digital information like the film speed, shutter speed or aperture and maximum aperture of the lens used to compute the necessary exposure information. To make it possible to transmit the 8-bit signals through a single line, the signal of each bit must be sent with a time interval and also must be received with the same time interval to be able to identify the signal to be received.

In the A-1, 240 micro-seconds is considered as one word and divided into 8 time zones (bits) names TB0-TB7 (Time Bus 0-7).

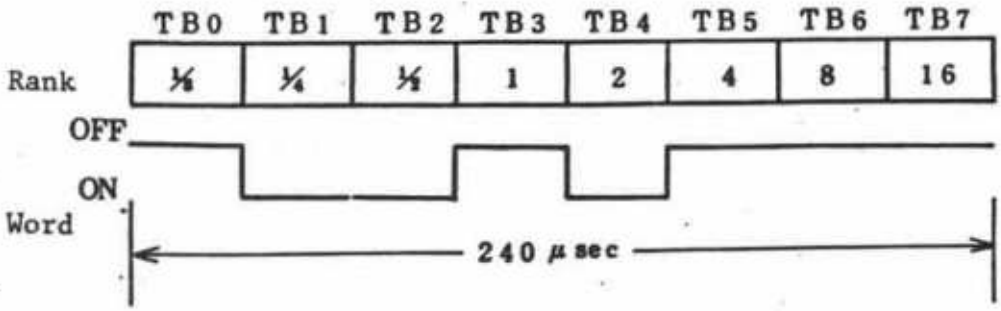
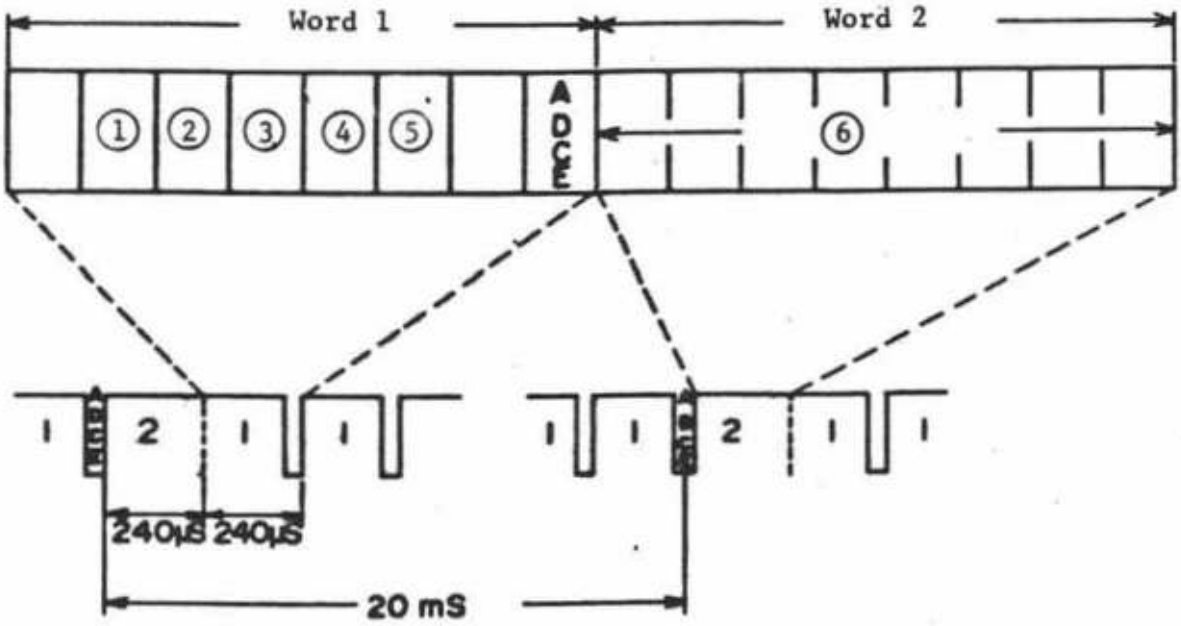


Fig. 15 Bus Line of 8-bit Signals

The A-1 processes more signals through several lines. An example is shown in Fig. 16.

Word 1 carries signals of various input digital information and Word 2 carries brightness value (BV) digital information which has been converted from analog information. Word 1 is being transmitted most of the time but the Word 2 is sent in turn immediately after the interruption by the signal of ADCE (AD Converter End) takes place at the end of transmission of the Word 1 every 20 milliseconds.



ADCE: End of analog to digital conversion

By the mode 1 and the mode 2, the following is detected.

*AE photography

*Battery check

*Use of the flash

*Setting of slower shutter speed for the 199A

① Manual ② Model 1 ③ Mode 2

④ Start of the display

⑤ Checking of the voltage

⑥ Analog to digital converted data

In thisway, it is possible to transmit many signals through one signal line.

Fig. 16 Bus Line

(10) Battery Check

1) Automatic Check

The A-1 has built-in safety mechanism in which automatic battery check function prevents the camera from working mistakenly when the battery has not sufficient voltage even if the shutter

button is pressed. In other words, when the electric current is applied to the MG1 (AE magnet), it also flows through the MG3 (2nd curtain magnet) at the same time and the present voltage is examined only for about 12 milliseconds. If this examination turns out to be approved, the electric current flows through the MG2 (1st release magnet) and the camera starts to work.

In this manner, the camera is not allowed to start to work unless the sufficient voltage is confirmed.

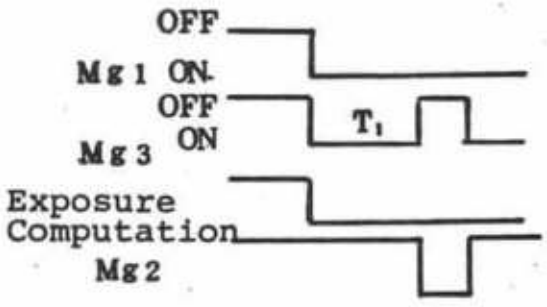


Fig. 17

2) Manual Battery Check

In manually checking the battery, electric current is applied to the MG1, MG2 and a registor of some load and the degree of the remaining power is known according to the way the LED blinks on and off.

Though the flashing cycle of the LED varies according to the voltage (for example, in the case of the voltage proportion of 6V to 3V, the LED flashes in the proportion of 4 to 1 times), if the LED flashes two or three times without much time lag the battery is considered to be good. If there is a considerable lag of time between the first flash of the LED and the following flashes, the battery is drained.

As to the relation between the automatic battery checking and the manual checking, since the load in manual checking is heavier than that of automatic checking though the voltage is the same, it can be said that safety margin is increased for manual checking in proportion to the load.

(11) Energy-saving Camera Design

When designing the A-1, every effort was made to reduce the power consumption. The result of these efforts is that the battery last for 15,000 operations, or about a year of normal use. The following items contribute to the low power consumption.

1) To apply the electric current to parts which really need the power at needed time by controlling the circuitry in sequence.

2) Adoption of the LSI which contains the pure I^2L, a refined version of the ordinary I^2L

3) Employment of the dynamic drive system for the diplay circuitry

4) Adoption of the "hybred magnet", a combination of the permanent magnet and the electromagnet

4.5 Physical Properties and Layout of Electrical Components

(1) Double-side micro pattern circuit boards

In the A-1, this flexible board is of multilayer construction with patterns on both sides. What's more, the minimum distance between lines and the minimum line width are 0.2 mm. This is a figure close to the limit obtainable by present techniques.

(2) Circuit Board Layout and interconnection

Figure 18 shows the block diagram of the circuit boards, and figure 19 shows a pictorial view.

On the top deck are positioned the main flexible board (IC for CPU, IC for information input, oscillator/ interface IC, IC for metering, etc.), SV board (diode array, film speed information input switch), At flexible board (self timer, power source switch) and AT board (At and TV information input switch).

In the front panel of the body are positioned the DD flexible board (includes decoder driver indicator), AV0 flexible board (for detecting maximum aperture opening f-number of the lens), and SAVE plate (to be explained later).

Of these, two-side flexible circuit boards are used for the main and DD flexible boards. The SAVE plate

is a two-sided flush plate (to be explained later). These flexible boards and various other boards are connected by rubber connectors and soldering.

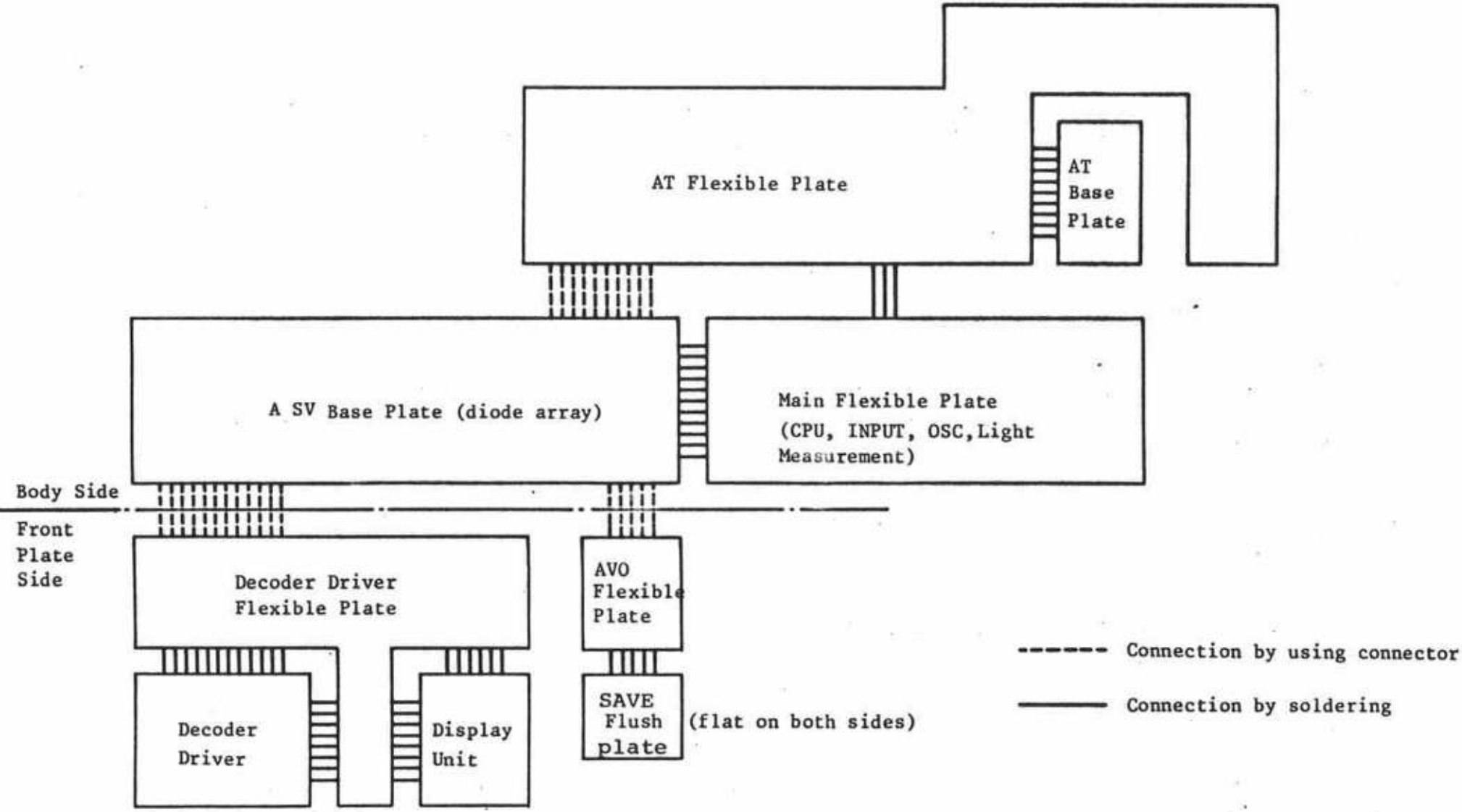


Fig. 18 Block Diagram of Circuit Boards

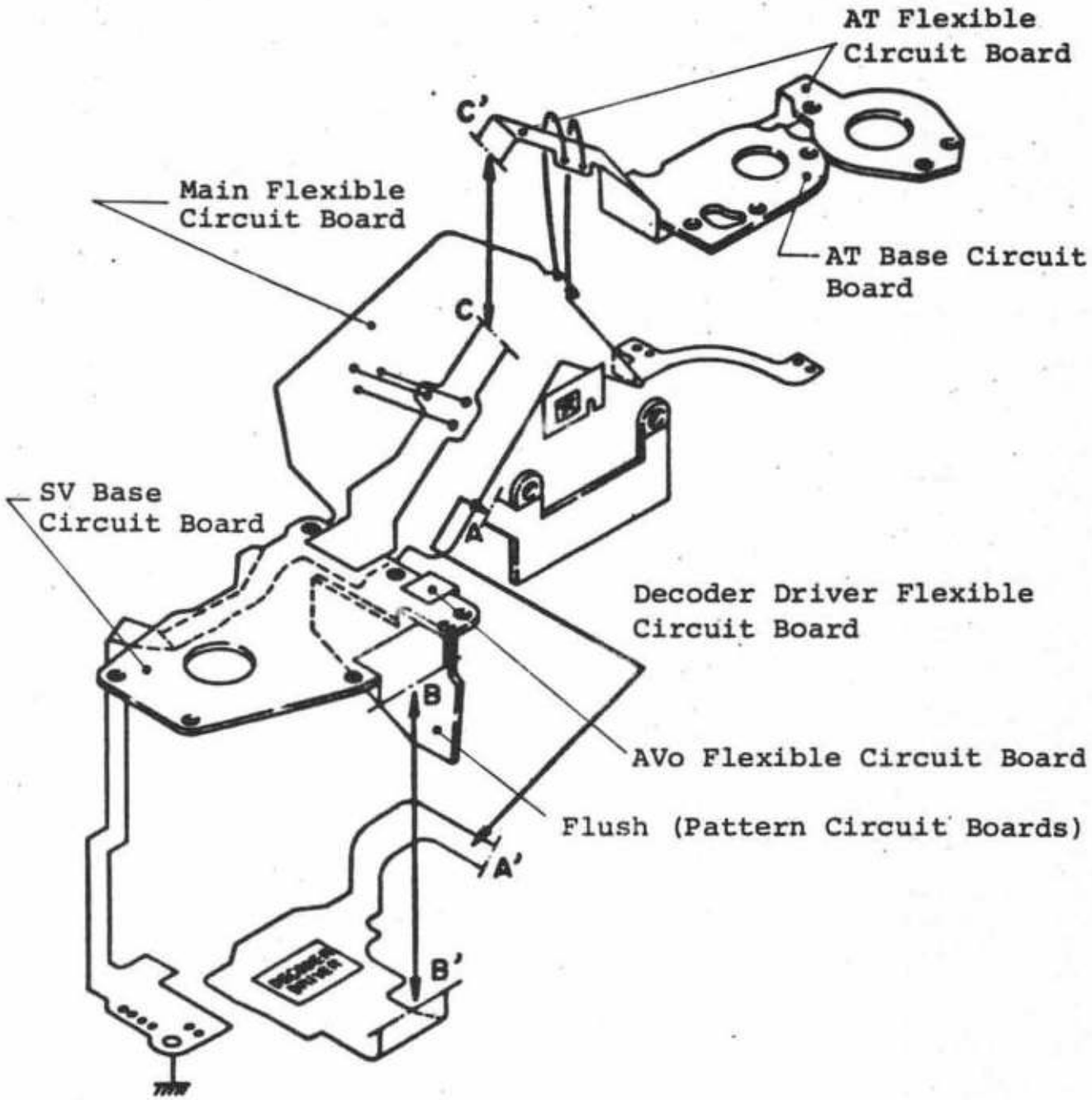


Fig. 19 Layout of Circuit Boards

3) Diode array

A diode array is a package of many diodes in the form of chips (A diode material. Diodes sold on the market are wired to lead wires by bonding and are glass sealed.). It is used for decreasing space requirements and for producing diodes of similar characteristics.

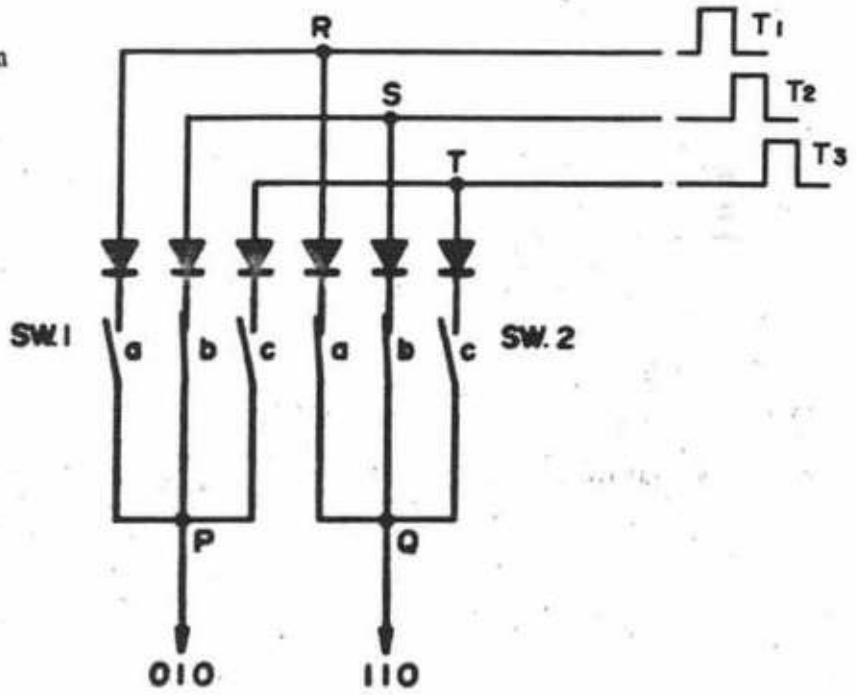
In the A-1, the various digital switches are connected in parallel. As this causes crossing of signals, signal separation diodes become necessary. The diode array is employed for this purpose.

Detailed explanations are given in Figure 20. (This example differs from the one used in A-1 and is simplified for the purpose of explanation.)

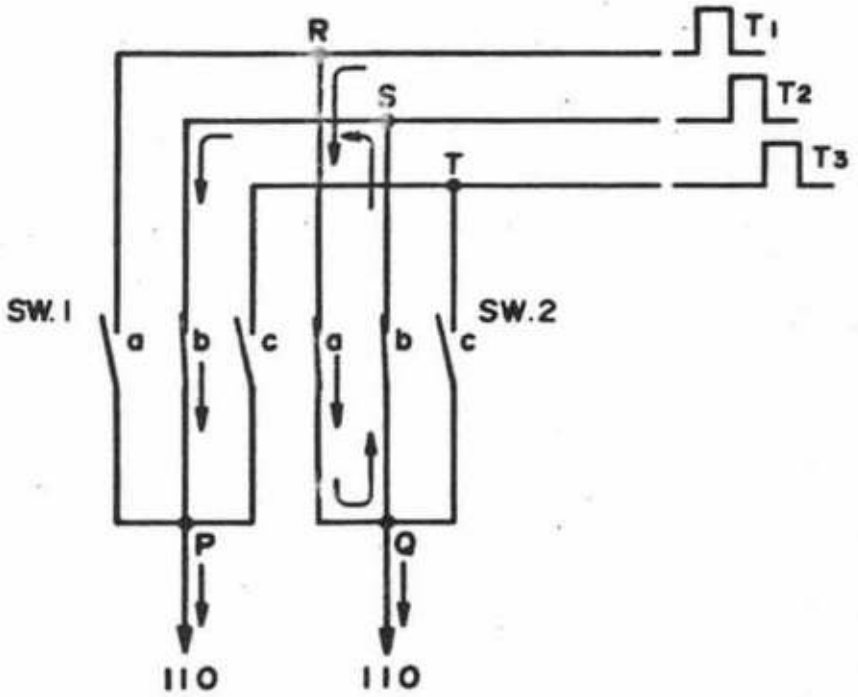
Digital switches S1 and S2 in Figure 20 are connected in parallel. In the figure, the condition of S1 is 010 and S2 is 110. When signals are taken out in time series, the outputs for S1 and S2 are 010 and 110 respectively. Now, if we think of the T1 signal, then S1 and S2 should become 0 and 1 respectively. In this case, the signals are transmitted in the order of R - S2a - Q - S2b - S - S1b - P. Therefore, the output for switch S1 becomes 1. In order to prevent this phenomenon, a diode is placed in each switch line to prevent crossing of signals.

In the A-1, a diode is placed in each of the 20 switch contacts. Therefore, the diode array is used for effectively using the limited space.

Fig. 20 Diode Array Diagram



a. Prevention of reverse flow with the use of diodes



b. Signal from T1 flows reverse to S1 as shown by the arrows and overlaps with the signal from T2

Reverse flow of signals

4) Ultra smooth double sided flush surface plate

The aperture control system of the A-1 is operated in the following manner. The brush, that is driven by the lens aperture signal lever, slides over the segmented aperture value electrode plate pattern at a high speed. The number of pulses of the ON/OFF signals that are generated at this time are counted and the f-numbers are digitally detected.

As the number of pulses are counted by ON/OFF signals mistaken counts due to chattering must be completely eliminated.

So a new technique was incorporated.
In the A-1, a segmented aperture value electrode plate pattern is formed on a 23μm (microns) copper foil plated "TETORON" reinforced epoxy board. This board is then heated and pressed. Thus, we succeeded in bringing the degree of smoothness of the board to within 5μm (microns). With the incorporation of this new technique, macro chattering no longer arises and micro-level chattering is eliminated by newly designed circuitry.

This smoothing process is called the flush process. Aperture control accuracy is improved by making the pitch smaller (0.22 mm) of the segmented aperture value electrode plate with the employment of high-level fine pattern techniques.

The segmented aperture value electrode plate (positioned on the outer side of the AE unit), used for this aperture detection, is called the SAVE (segmented aperture value electrode) plate.

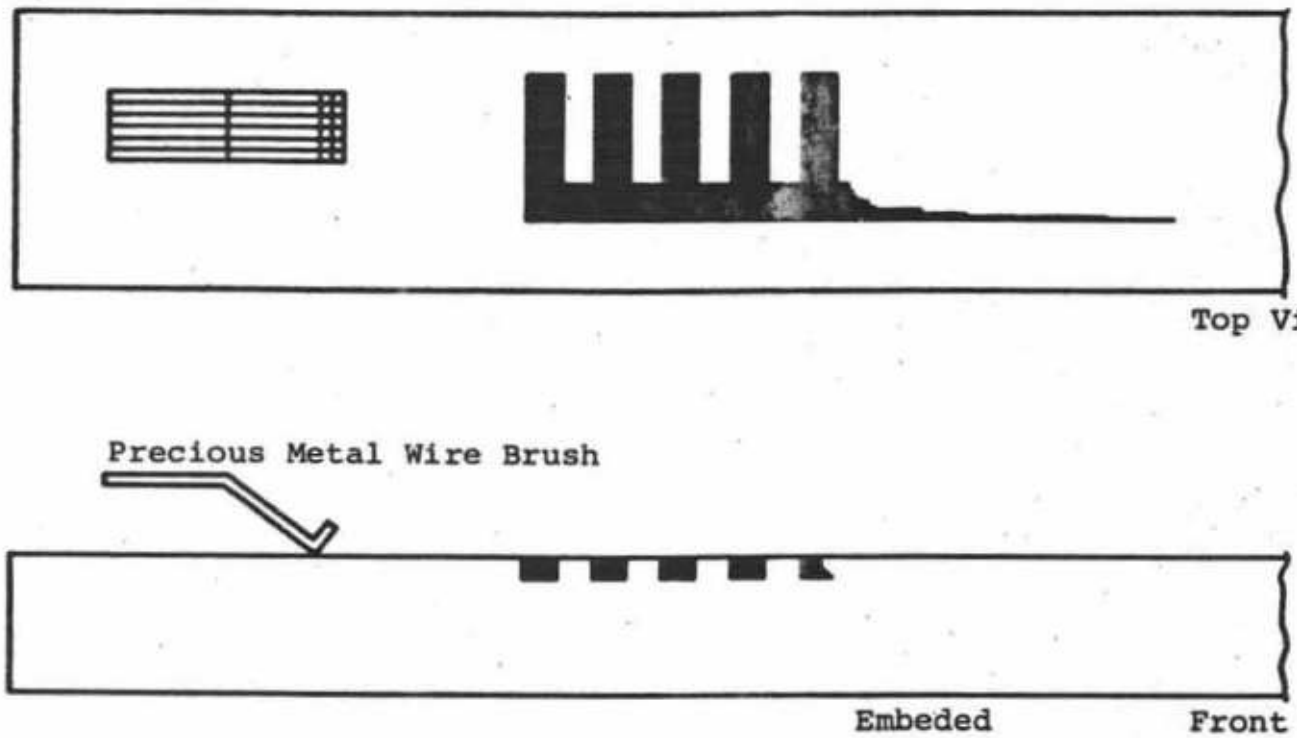


Fig. 21 Segmented Aperture Value Electrode Plate

(5) Micro pattern digital switch

Various kinds of information are input by digital values. Therefore, digital switches, constructed of a code plate and slide brush, are employed.

The code plate employs the usual 35 μm thick copper foil plated print board with gold-plated print pattern. The mechanical durability is guaranteed for one million operations.

(6) Mini connectors

In the A-1, small mini connectors are used between circuit boards, especially in places where attaching/detaching functions are desirable.

The following points are connected by mini connectors.

Wiring (12 conductors) connecting the display/decoder driver flex to the main flexible circuit board.

Wiring (5 conductors) connecting the lens maximum aperture correction information input switch to the main body.

The wiring from the AV, TV and self timer information input switches (10 lines) on the right side of the top deck is connected to the main flexible circuit board near the top of the pentaprism.

The problem of space prevents the use of ready-made connectors for the above-mentioned connections. Therefore, what is used is a connector utilizing aligned patterns pressed together by rubber. This method makes possible very compact connectors.

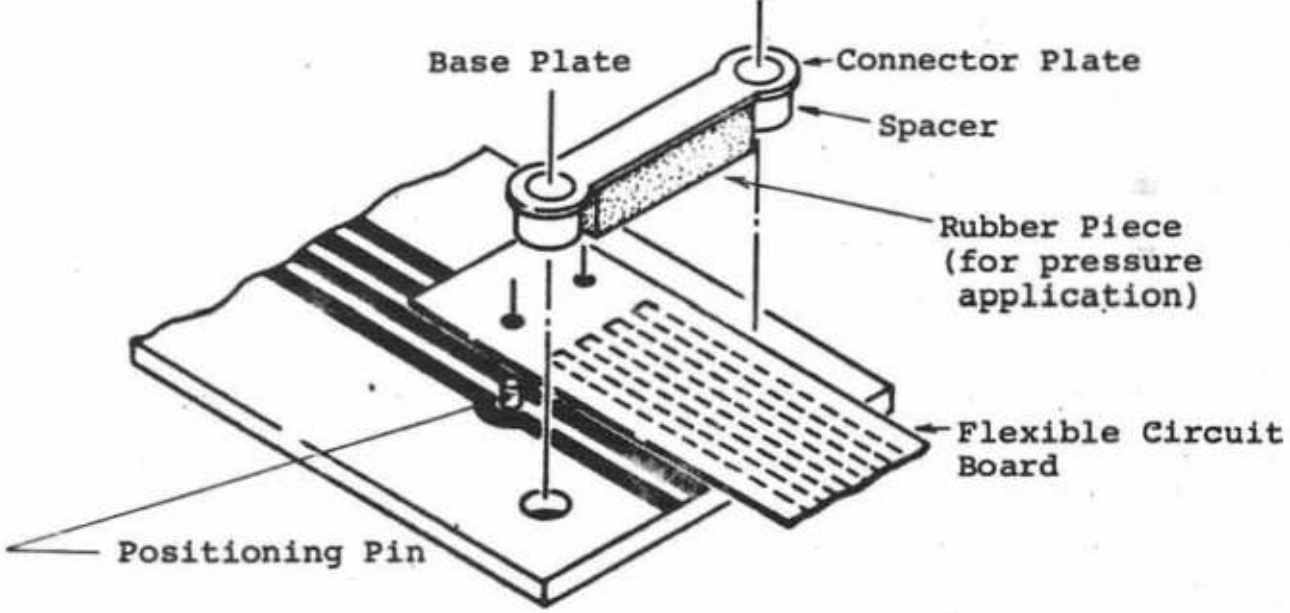


Fig. 22 Mini Connector

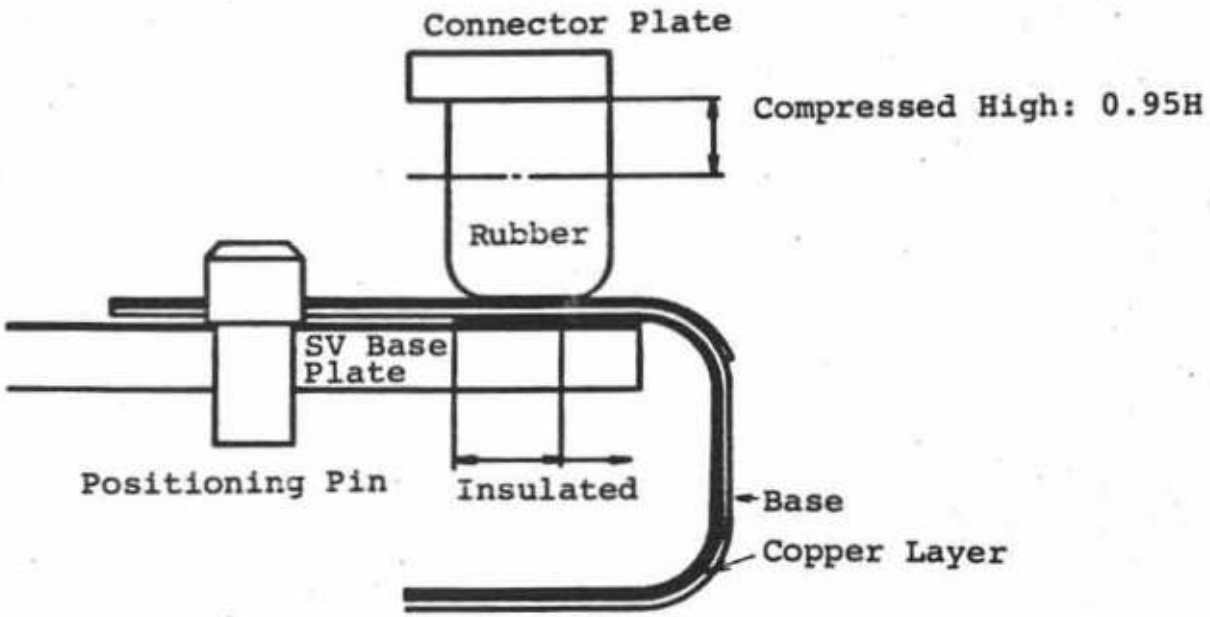


Fig. 23 Mini Connector (cross section)

(7) Others

1) Hybred magnet

When the shutter button is released, a magnet starts functioning the camera. This magnet, like the one used in the AE-1, is a hybred magnet employing a permanent magnet and an electromagnet. However, the hybread magnet installed in the A-1 employes an additional alloy, made of rare earth element (samarium) and cobalt, in the magnetic body section.

2) Temperature compensating resistor

A wire-wourd resistor was used for the temperature compensating resistance in the AE-1. In the A-1, reliability is further increased by employing a special metal film resistor.

4.6 Mechanisms

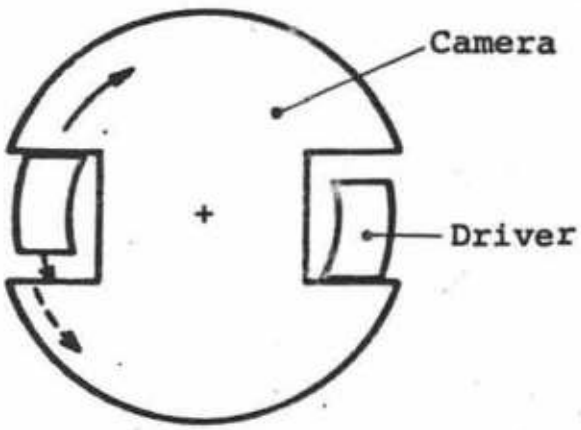
The A-1 is composed of five main units (finder, shutter, automatic diaphragm, AE and mirror units) and 31 sub-units. These units are attach to the body diecast without need for adjustments. Basically, this is similar to the AE-1. However, its specifications are designed to withstand harder conditions such as the use of the five frames per second Motor Drive MA.

(1) New MD Coupler

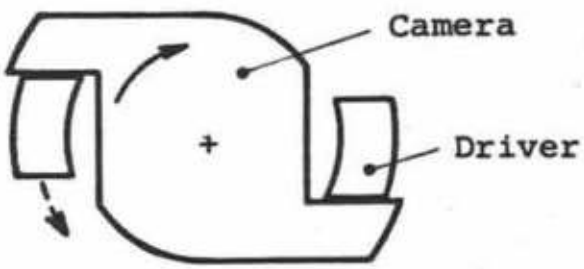
Figure 24 shows the shape of the MD Couplers for the AE-1 and A-1.

When continuous shooting is performed with a conventional coupler and Motor Drive MA, the coupler collides into the winding stopper of the camera when winding is completed. As a reaction, the couplers on the camera side and drive side have some backlash. At this time, the Camera coupler stops after being returned slightly by the reversal stopping spring. But the motor drive coupler continues reversing by inertia and collides into the wall on the opposite side of the camera coupler. This moves the once stopped camera coupler still further in reverse direction by 0.05 mm to 0.4 mm. This phenomenon causes the film to move during exposure. This results in a flowing-like blurred picture. For this reason, in the A-1, the revers side of the MD Coupler on the camera has been positively designed so it is no struck by the motor drives coupler during backlash

This prevents the MD Coupler from being moved again by the Motor Drive MA Coupler.



Conventional System



A-1 System

Fig. 24 MD Coupler

The features of this mechanism are as follows:

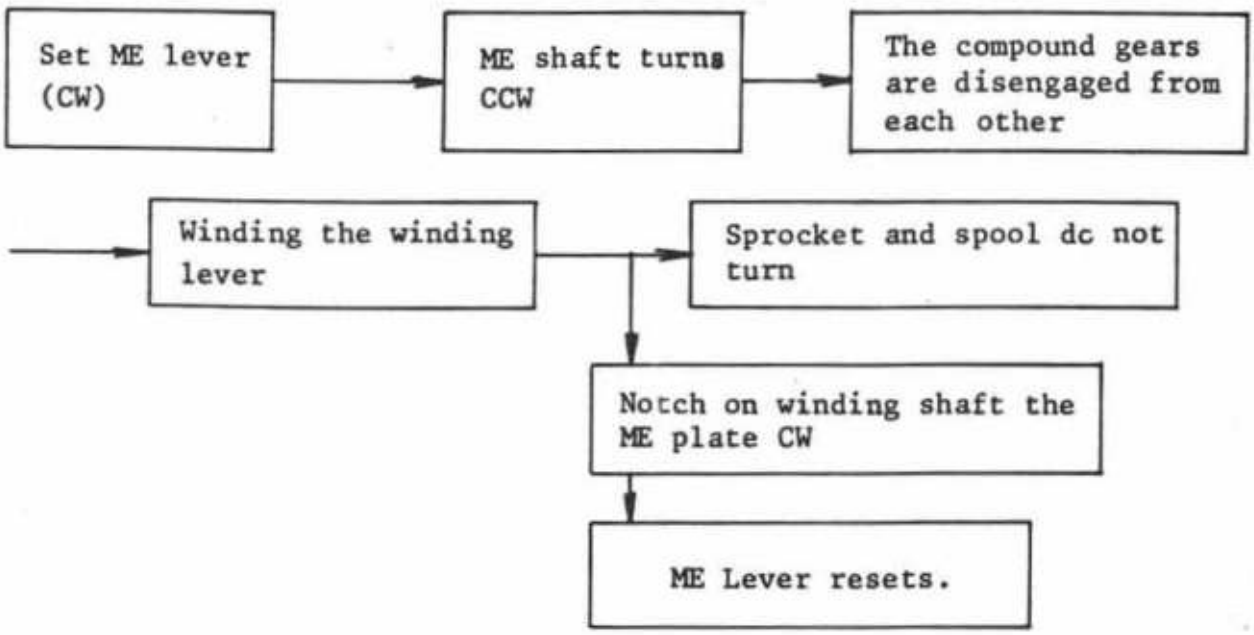
1) The functioning of the new MD Coupler, mentioned in section 4.6.1, prevents flow-type blurring of pictures otherwise caused by Motor Drive MA.

2) Nonchattering signals SW5 and SW5' are possible due to the functioning of the microbrush.

3) Since the second shutter curtain signal releases the wind stopper, it prevents accidental winding while the shutter is functioning even during long exposure times.

4) The many steel ball bearings used on the top and bottom of the winder shaft increase reliability and durability.

(3) Multiexposure Mechanism


Set ME lever (CW)
ME shaft turns CCW
The compound gears are disengaged from each other
Winding the winding lever
Sprocket and spool dc not turn
Notch on winding shaft the ME plate CW
ME Lever resets.

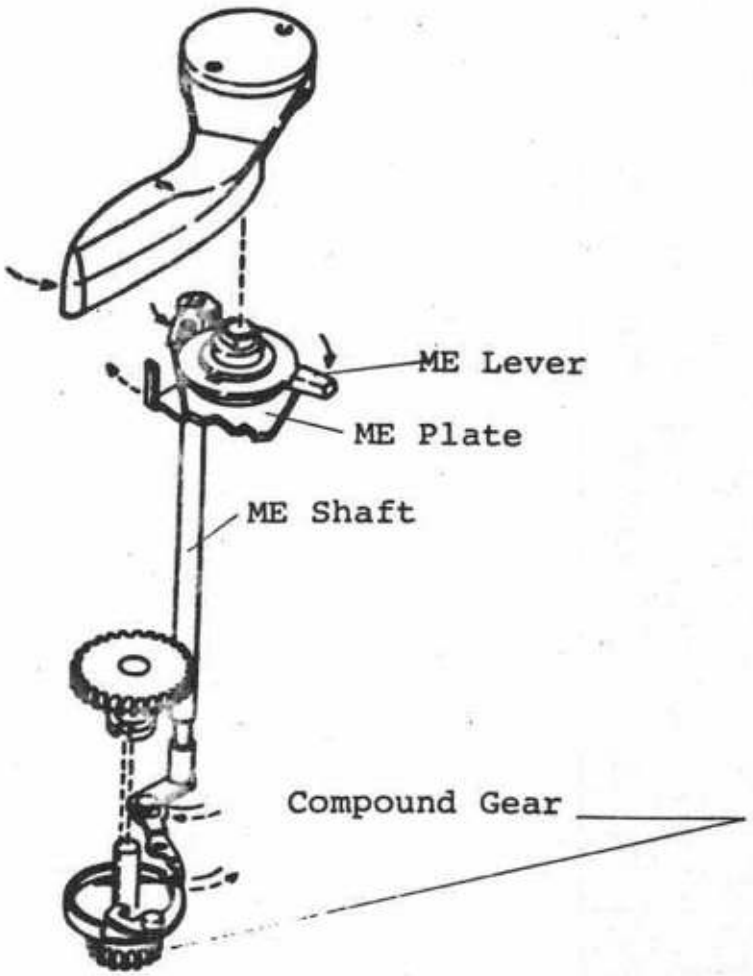


Fig. 25 Multiple Exposure Mechanism

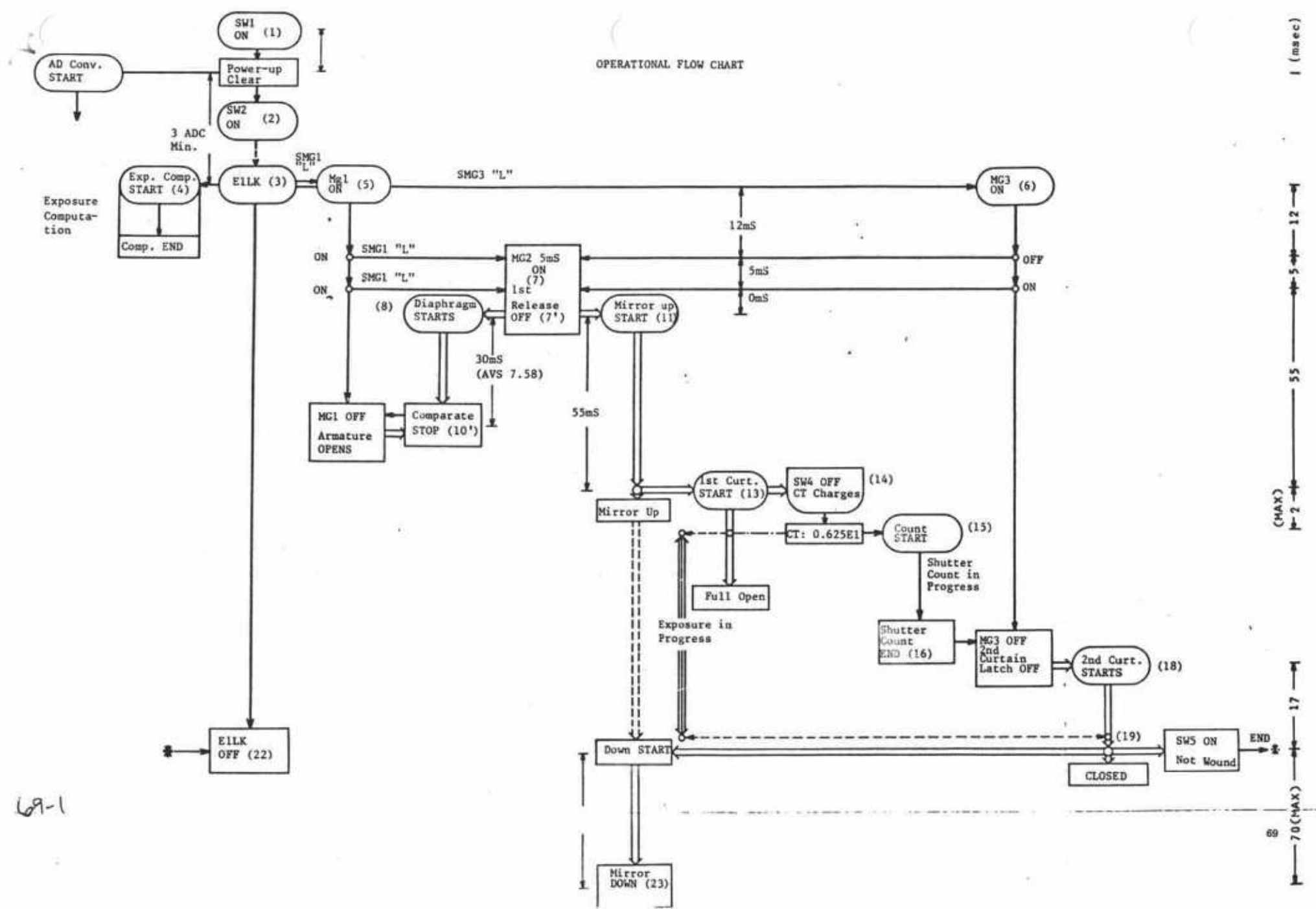
The features of this mechanism are as follows:

1) Multiexposure is made possible with a camera having a sprocket with only six teeth and in which short stroke winding is possible. Furthermore, short stroke winding is possible even during windup after multiexposure has been set.

2) As a clutch is constructed before the sprocket and spool drive gear, it is not necessary to fix the spool when multiexposure has been set. (Contributes to decreasing the number of parts.)

3) The automatic reset mechanism eliminates worries about forgetting to reset the camera after multiexposure.

4) By setting the multiexposure, the wind stopper is released. Therefore, even in AE discharge condition after windup (EEEE EE) mark display), AE recharge can be performed without wasting a single frame.


OPERATIONAL FLOW CHART
SW1 ON (1)
AD Conv. START
Power-up Clear
SW2 ON (2)
3 ADC Min.
Exp. Comp. START (4)
Exposure Computa-tion
Comp. END
E1LK (3)
SMG1 "L"
Mg1 ON (5)
SMG3 "L"
MG3 ON (6)
12mS
5mS
0mS
ON
SMG1 "L"
ON
SMG1 "L"
MG2 5mS ON (7) 1st Release OFF (7')
OFF
ON
(8)
Diaphragm STARTS
Mirror up START (11)
30mS (AVS 7.58)
55mS
MG1 OFF Armature OPENS
Comparate STOP (10')
Mirror Up
1st Curt. START (13)
SW4 OFF CT Charges
(14)
CT: 0.625E1
Count START
(15)
Shutter Count in Progress
Full Open
Exposure in Progress
Shutter Count END (16)
MG3 OFF 2nd Curtain Latch OFF
2nd Curt. STARTS
(18)
(19)
SW5 ON Not Wound
END
CLOSED
Down START
E1LK OFF (22)
Mirror DOWN (23)
1 (msec)
2 (MAX)
55
12
5
17
70(MAX)
69
69-1

OPERATIONAL FLOW CHART DETA... (Numbers Refer to Flow Chart)

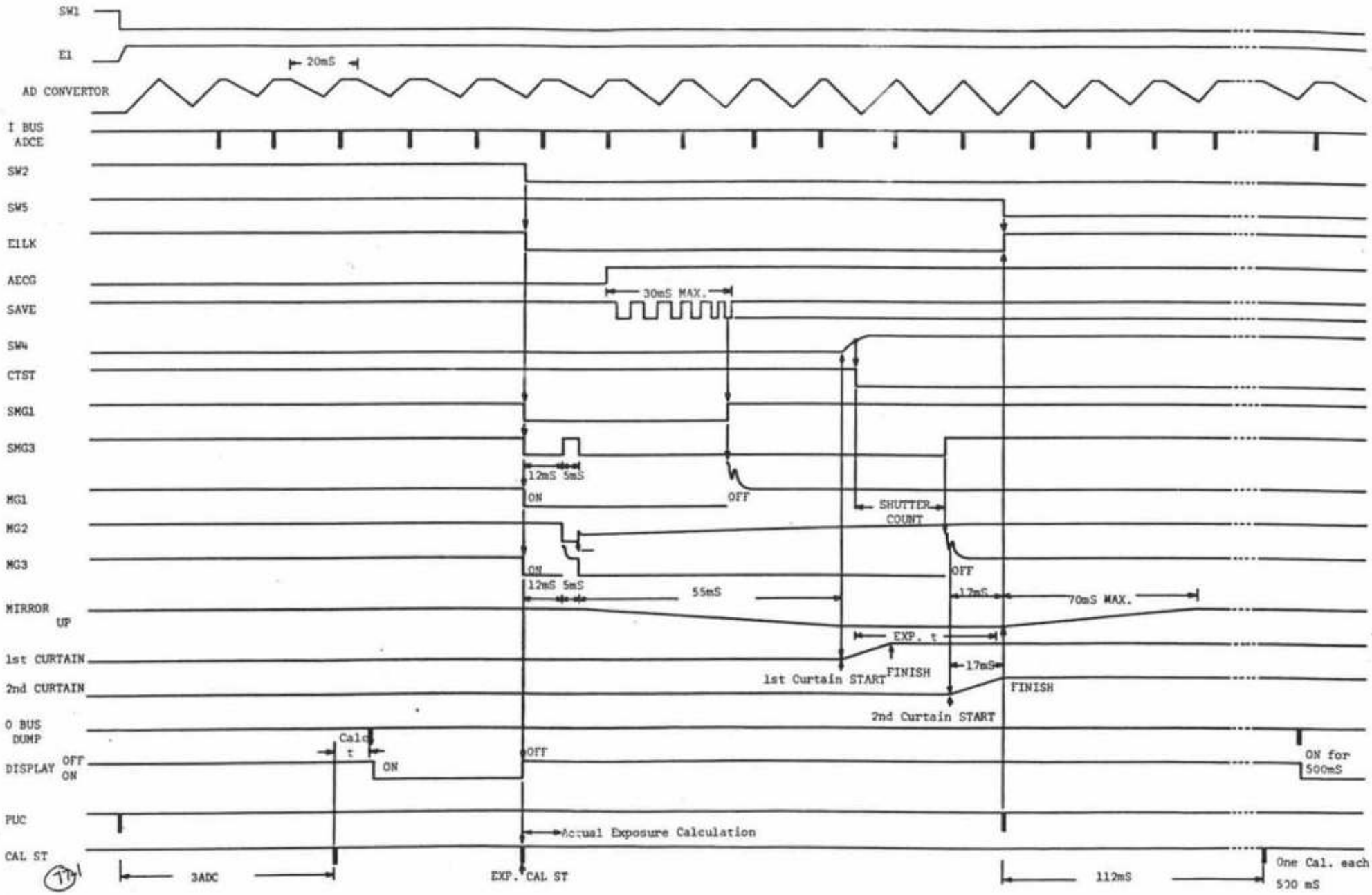
Mechanical	OPT	INPUT	CPU	OSC/INTERFACE	Decorder Driver
SW1 ON PNP Tr ON E1 Supplied	E1 starts OPT. SPC output amplified to MOS OUT and sent to INPUT IC	E1 sets "power-up clear" KVC output When CLK and D7 input T.B.O thru T. B7 generated AD Comprator operates At end of AD comp ADCE generated Output of AD Comp. (BV) thru I Bus to CPU As long as E1 is present, AD comp. sends BV signal every 20 mS.	Each MODE and LV etc check and send various data thru MPX and I BUS to CPU Until E1 Off, one word each 240μS is sent to CPU KVC and BIAS input sets "power-up clear" Until three AD comparisons are completed (3ADCE), all actions are held. After 3ADCE, incorrect conditions (EEEE, LV) are checked (Before 1st release) If OK, following occure: If SW2 closed exposure calculation and exposure start. (providing shutter is charged). If SW1 only closed, display processing starts. When display signal is finished, dump signal sets for transmission of TV, AV etc. signals thru the O BUS to the Decoder Driver. At other times intensiting and flashing information is sent thru the O BUS to the Decoder Driver.	E1 sets "power-up clear" With KVC input, voltage developed across ROSC starts the oscillator. Clock pulse starts KVC and CLK generate BIAS	E1 sets "power-up clear" Clock pulse input T.B O - 7 present D-1 - 7 power When dump is received, TV, AV etc. signals are decorded the exposure information is displayed. After intial display the process is repeated every 500mS.

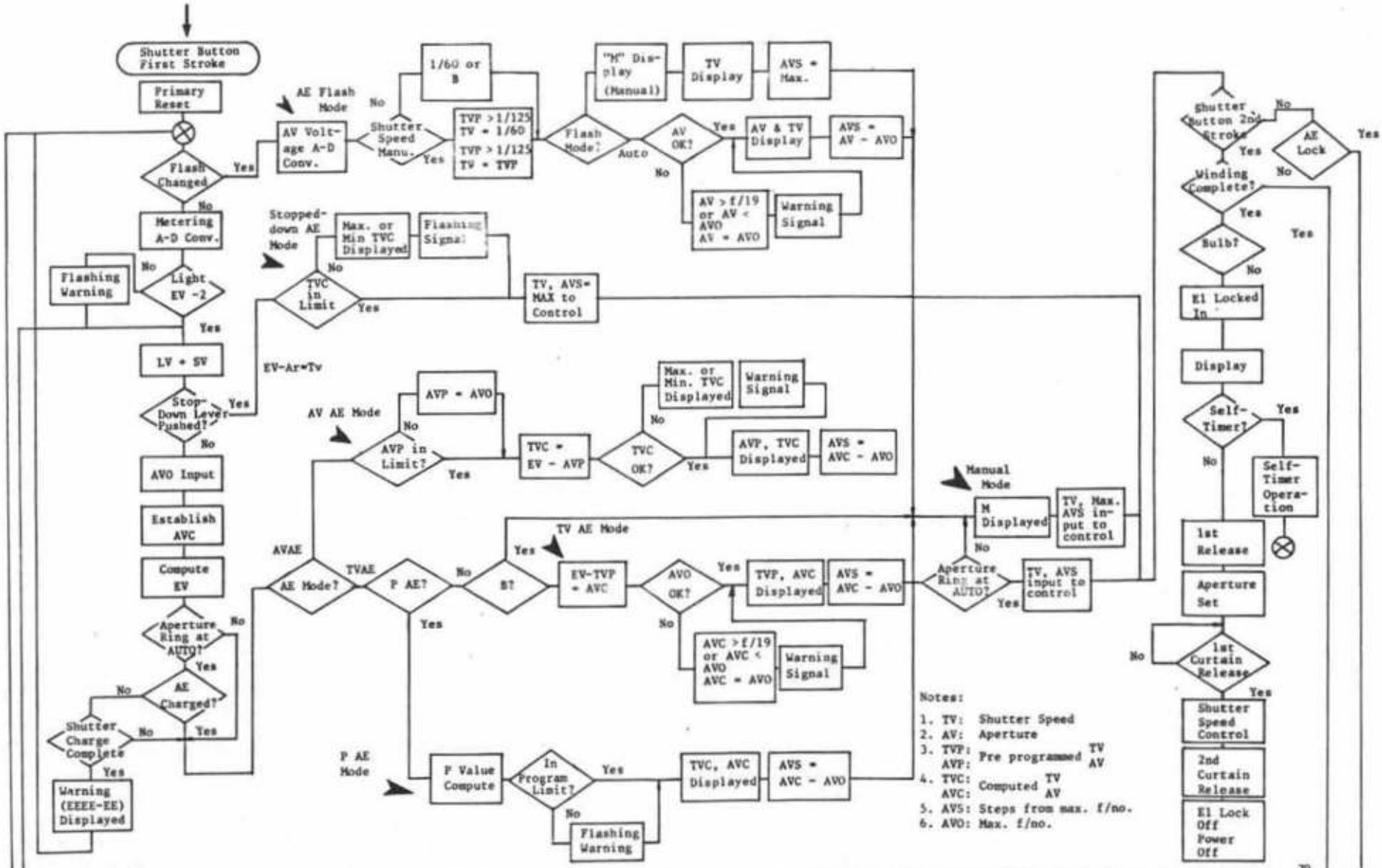
71-1

Mechanical	OPT	INPUT	CPU	OSC/INTERFACE	Decorder Driver
			After SW 2, and until E1 off, display signal continues to be sent every 500mS.		
	MOS OUT in progress	AD Conv. in progress (one per 20mS)			During display, flashing and intensity information is supplied. At SW 2 ON display information is cancelled.
(2) SW 2 ON			E1LK goes "L"	E1LK goes "L" switches PNP to "L". This locks the power supply transistor "ON". (Power lock-in)	
(3) PNP "L" puts TR in the automatic hold condition			All flow action returns to start position for actual calculation. DISP Signal goes "H"		
			(4) Actual exposure calculation starts — SMG1, 3 go "L"		If DISP signal goes "H" display does not light.
(5) MG1, MG3 ON (6)			While current is flowing thru MG 1 & 3 exp. calculation takes place and TV is stored in the A register. — MG1, MG3 energized to check if battery power is sufficient. Current flows for 12mS.		
			If during the 12mS test period, the computer determines that the battery power is insufficient, the LV signal is generated and sent thru the I BUS. This cancels all actions and switches the E1LK to "H" to the shutter cannot be released.		
(7) Current thru MG2 releases it			12mS after E1LK goes "L", SMG3 goes "H" and SMG1 is "L". This condition last 5mS causing (7).	Combination of SMG3 "H" and SMG1 "L" sends current thru SMG2 coil releasing it. (At this time SMG3 is electrically released for 5mS but it is held mechanically during this time.)	
(7') First release is released.					

Mechanical	OPT	INPUT	CPU	OSC/INTERFACE	Decorder Driver
(11) Mirror starts up	(8) Diaphragm moving AECG OFF SAVE pulse to CPU		SAVE pulse input is compared to A register AVS value. (9) When SAVE pulses = AVS, SMG1 goes "H".	(10) When SMG1 goes "H", MG1 is turned off.	
	(10) When MG1 off, aramature is released and (10') stops the diaphragm.				
(12) Just before, mirror is completely up, 1st curtain is released.					
(13) As 1st curtain starts SW4 goes off.					
(14) At SW4 off, CT starts charging.				(14) CT starts charging, and at 0.625 E1 V (62.5% of E1) CTST goes "L"	
			(15) When CTST goes "L", the shutter speed count starts.		
			(16) When shutter speed count is finished, SMG3 signal goes "H"		
(17) When MG3 is released, the 2nd curtain latch is released.				(17) When SMG3 goes "H", current flow thru MG3 stops and it is released.	
(18) 2nd curtain runs closing the shutter and terminating the exposure.					
(20) Mirror stopper released	(21) SW5, 5' turned ON		When SW5 goes ON ("L") generates power-up clear "signal and E1LK goes "H".		
Mirror moving down	(22) PNP goes "H" so TR goes OFF, E1 lock-in is cancelled.			(22) When E1LK goes "H", PNP goes "H". The power transistor TR is turned off, and E1 supply is terminated.	
(23) Mirror in down position.					

75-1


SW1
E1
20mS
AD CONVERTOR
I BUS
ADCE
SW2
SW5
E1LK
AECG
30mS MAX.
SAVE
SW4
CTST
SMG1
SMG3
12mS 5mS
MG1
ON
OFF
SHUTTER COUNT
MG2
MG3
ON
OFF
12mS 5mS
55mS
17mS
70mS MAX.
MIRROR UP
EXP. t
1st CURTAIN
1st Curtain START
FINISH
17mS
2nd CURTAIN
FINISH
2nd Curtain START
O BUS DUMP
Calc t
DISPLAY OFF ON
ON
OFF
ON for 500mS
PUC
Actual Exposure Calculation
CAL ST
3ADC
EXP. CAL ST
112mS
One Cal. each 500 mS



79

79-1

A-1 Flow Chart

SYSTEM TIMING CHART

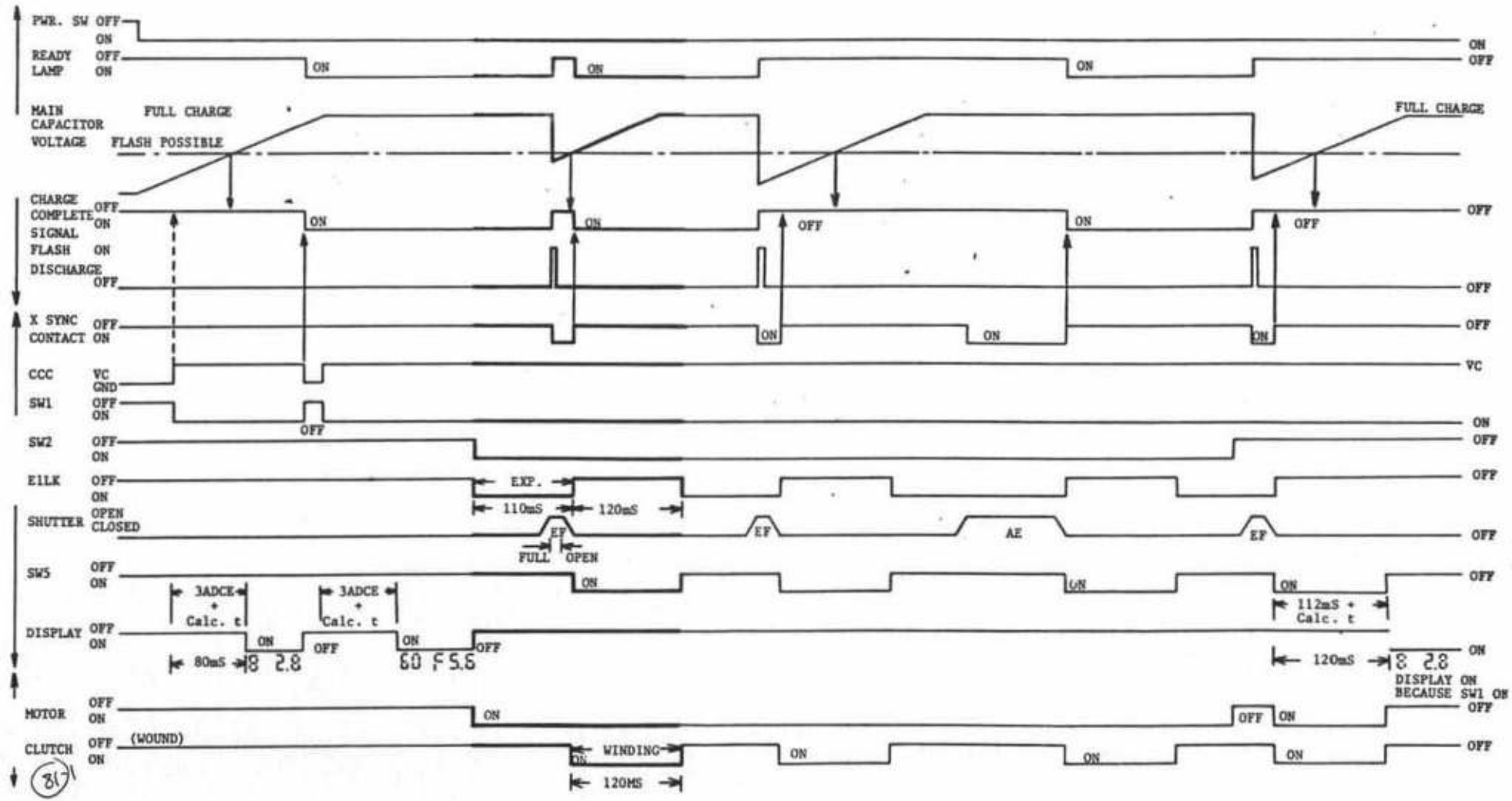
A-1, 199A, MD - MA

199A: Shutter Speed- Auto
Aperture "A" - f/5.6
ASA - 100

MD - MA: Mode - H

A-1: MODE Dial - AV or TV
T/A - f/2.8 or 1/8
ASA - 100

FD LENS: - A



6. Technical Comments

6.1 Quality Criteria

(1) Using the AE-1 as a base, and with the goals of using as many AE-1 parts as possible and holding production cost to a reasonable level, to produce a product with 50,000 plus operation durability.

(2) As a successor to the EF, the product must be at least equal in quality to the EF.

(3) Using digital techniques and the latest precision electronic technology, to build an extremely versitile product with accurate operation and excellent reliability.

6.2 The operation of mechanical parts is based on the AE-1, but the electrical operation is digital rather than analogue. The use of a dual-trace oscilloscope is practically imperative. A digital voltmeter is not suitable as the prime test instrument for this camera.

6.3 The camera uses five integrated circuits. It is necessary to thoroughly understand the operation and interaction between the IC's to successfully repair the camera. (Understanding of Internal operation of individual IC's is not necessary).

6.4 If the digital inputs for shutter speed, aperture, ASA, maximum aperture, self timer etc. are not correctly adjusted there will be a direct affect on the viewfinder information and exposure accuracy. Each input has a check point built into the pattern. The tolerances are very tight and careful adjustment is necessary.

6.5 The flexible circuit boards have patterns on both sides of the boards. Limited space makes it nearly impossible to install jumpers on the back side of the flex, so caution should be taken not to break the flexible pattern during repair.

6.6 To raise the durability to the level established by the quality criteria, many AE-1 parts have been improved. Some of these parts appear to be identical but there are differences in material or manufacture. Strict parts control is required to insure that the correct parts are

used in the correct camera. Lubrication is also different from the AE-1.

6.7 The A-1 is a system camera. Interchangeability and correct operation with accessories must be considered when repairing it.

6.8 The viewfinder screen is interchangeable by service. When it is changed, always check the infinity focus and exposure.

6.9 Much information is presented in digital form in the viewfinder, and it is different for each mode of operation. If the information presented in all different modes is not thoroughly understood, answering inquiries, especially over the telephone, is difficult and may lead to more confusion.

6.10 Repair Quality Assurance

(1) Shutter Speed is adjusted by varying the count start (CTST) timing with variable resistor VRT. (Shutter Speed Tester is necessary)

(2) Flange Focal Distance is adjusted to 42.14 mm using the Glass gage and measuring at the four corners.

(3) The "finder back" is adjusted to 42.03 mm using the standard lens.

(4) Exposure accuracy is adjusted by the SPC output using the Bus Checker tool to check the I Bus. It is then confirmed using the EE Camera Tester. If exposure accuracy is not within the proper limits, check the diaphragm and MG1 release operation with the oscilloscope. (If the AE Evaluation Standard Lens is available, check the diaphragm operation with it.)

(5) Check the O BUS output from the CPU to the decoder driver against the actual display in the viewfinder using the Bus Checker tool. (I Bus inputs to the CPU must be correct as a precondition.)

(6) Inputs to CPU are checked with the Bus Checker tool.

(7) To adjust the ASA (SV) brush, the SV Check Bit tool is used. The top cover provides the positioning pin for the SV Check Bit tool.

INTRODUCTION

The CANON A-1 is the pinnacle we have been striving for in an AE SLR-- a completely digitally controlled camera.

The mechanical parts are based on, and nearly identical to, the AE-1. To troubleshoot and repair the A-1, experienced gained on the AE-1 is important, and consideration of digital timing is necessary.

The electrical circuit of the A-1 is quite different from the AE-1. The main components are five intergrated circuits, (OPT, INPUT, CPU, OSC/INTERFACE and DECODER DRIVER). Digital signals criss-cross to and from these IC and to their mechanical interfaces. To repair the camera, signal sequence and timing must be understood. Digital basics, including code reading, and oscilloscope operation are other necessary skills.

Special Precautions

1. Many parts are interchangeable between the A-1 and AE-1. However, other parts that appear quite similar to AE-1 parts are either slighly different in size, strength or material and are not interchangeable. Special attention should be paid to parts control to insure that the correct parts are used.

2. The A-1 shutter is controlled in 1/8 step intervals. For this reason the 2nd curtain latch adjustment has been changed. Rather than having a space between the latch and latch cam, they press against each other in this design.

3. Because of the digital control, the positioning of the information input brushes is very important. Each one has a special check point built into the pattern. This point (called a check pattern or check bit) should be used to accurately adjust the contact. If improperly adjusted, improper exposure or viewfinder information will result. Especially, if the AV brush (Section 2-11) is not correctly adjusted, the error mark (EEEE EE) will be displayed and the shutter will be locked.

4. The maximum aperture pin height adjustment (Section 2-8, 2-9) is different from the AE-1. See section 2-8 and 2-9 for the correct procedures. This adjustment has a direct effect on the viewfinder information and should be accurately performed.

5. Lock-out voltage (LV): The low voltage interlock for this camera is 3.1 to 3.5 volts.

6. When their IC is replaced the R OSC and R ADNUL must be correctly adjusted. The adjustment is different from the AE-1 adjustment and it has a direct effect on the viewfinder display. (See Section 4, IC Replacement).

7. The flexible circuits used in the A-1 are high densitity with patterns on both sides. Jumper wires cannot be used. Care should be taken not to crimp or break the pattern when installing the top cover.

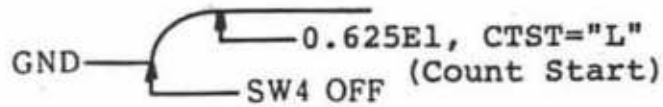
8. Certain voltages and signals are basic. They are E1 (Supply voltage) for each IC, CLK (clock pulse) SYNC (D7) (the synchronization trigger), I. BUS (input busline) and O. BUS (output busline).

9. In order to understand the A-1 circuit, it is necessary to study the detail operation of each IC as outlined in section 3 of this repair guide.

10. The A-1 is a system camera. It uses the following major accessories: POWER WINDER A, MOTOR DRIVE MA, SPEEDLITES 155A and 199A, DATA BACK A and WIRELESS CONTROLLED LC-1 as well as all the FD lenses and other accessories. Operation with the various accessories must be considered when repairing the basic camera.

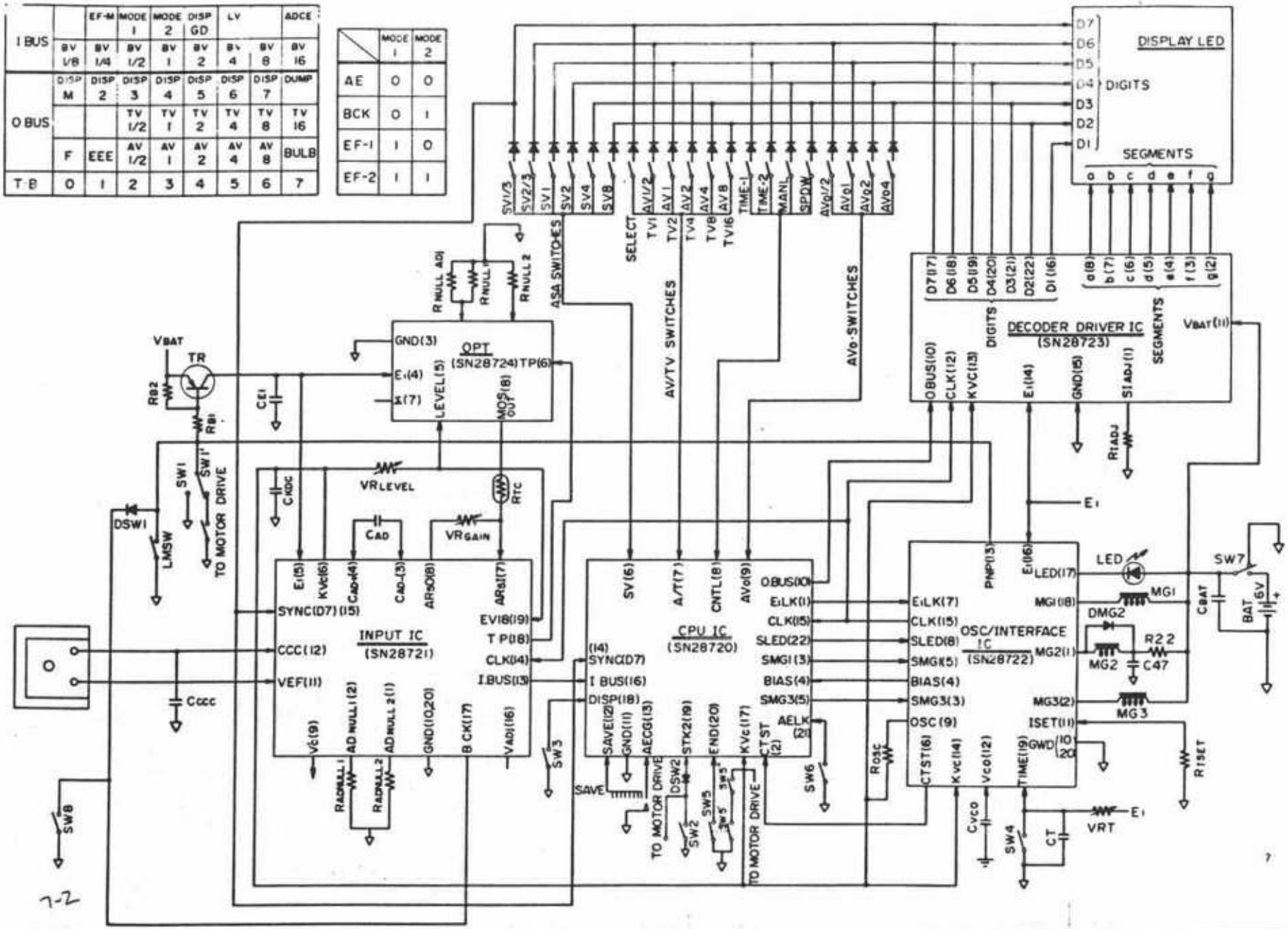
11. Since the mechanical design is similar to the AE-1, the common repair operations have not been included in this guide. Refer to the AE-1 Repair Guide.

SWITCH TABLE

<table>
<tr><th>Switch</th><th>Name</th><th>Function</th></tr>
<tr><td>SW1</td><td>Metering Switch-1</td><td>ON at shutter button half stroke</td></tr>
<tr><td>SW1'</td><td>MD Metering Switch-1</td><td>Motor Drive metering switch</td></tr>
<tr><td>LM SW</td><td>Light Metering Switch-2</td><td>Exposure preview Switch</td></tr>
<tr><td>SW2</td><td>Release Switch</td><td>ON at shutter button full stroke</td></tr>
<tr><td>SW3</td><td>Display Switch</td><td>Finder display control switch
Switch ON = Gnd. Switch OFF = H</td></tr>
<tr><td>SW4</td><td>Count Switch</td><td>Shutter time initiation switch
 
</td></tr>
<tr><td>SW5</td><td>Winding Completion SW</td><td rowspan="2">SW5-5' indicates winding condition.
"L" = Gnd.
<table>
<tr><th rowspan="2">Model</th><th colspan="2">Wound</th><th colspan="2">Released</th></tr>
<tr><th>AE-1</th><th>A-1</th><th>AE-1</th><th>A-1</th></tr>
<tr><td>SW5</td><td>L</td><td>H</td><td>H</td><td>L</td></tr>
<tr><td>SW5'</td><td>H</td><td>H</td><td>L</td><td>L</td></tr>
</table></td></tr>
<tr><td>SW5'</td><td>MD Winding Completion SW</td></tr>
<tr><td>SW5"</td><td>ME SW5' Disable SW</td><td>In series with SW5', this switch prevents motor drive operation if the multiple exposure lever has been pressed.</td></tr>
<tr><td>SW6</td><td>AE Lock SW</td><td>Records and holds measured EV when pressed. (Exposure memory switch)</td></tr>
<tr><td>SW7</td><td>Power (Main) Switch</td><td>A - L switch</td></tr>
<tr><td>SW8</td><td>Battery Checker SW (Clear SW)</td><td>Battery Check- 4-5Hz flashing LED (Clears all circuits in mid operation)</td></tr>
<tr><td>TIME 1</td><td>2 sec. Self Timer</td><td rowspan="2">During self timer operation, LED frequency is 8 Hz for last 2 seconds, and 2 Hz for first 8 seconds.</td></tr>
<tr><td>TIME 2</td><td>10 sec. Self Timer</td></tr>
<tr><td>SPDW</td><td>Stop-down Switch</td><td>ON when stop-down lever pushed</td></tr>
<tr><td>A-MSW</td><td>Auto-Manual SW</td><td>OFF with lens at "A", ON otherwise</td></tr>
<tr><td>AV/TV SW</td><td>Priority Mode SW</td><td>Selects aperture or shutter speed priority.</td></tr>
</table>

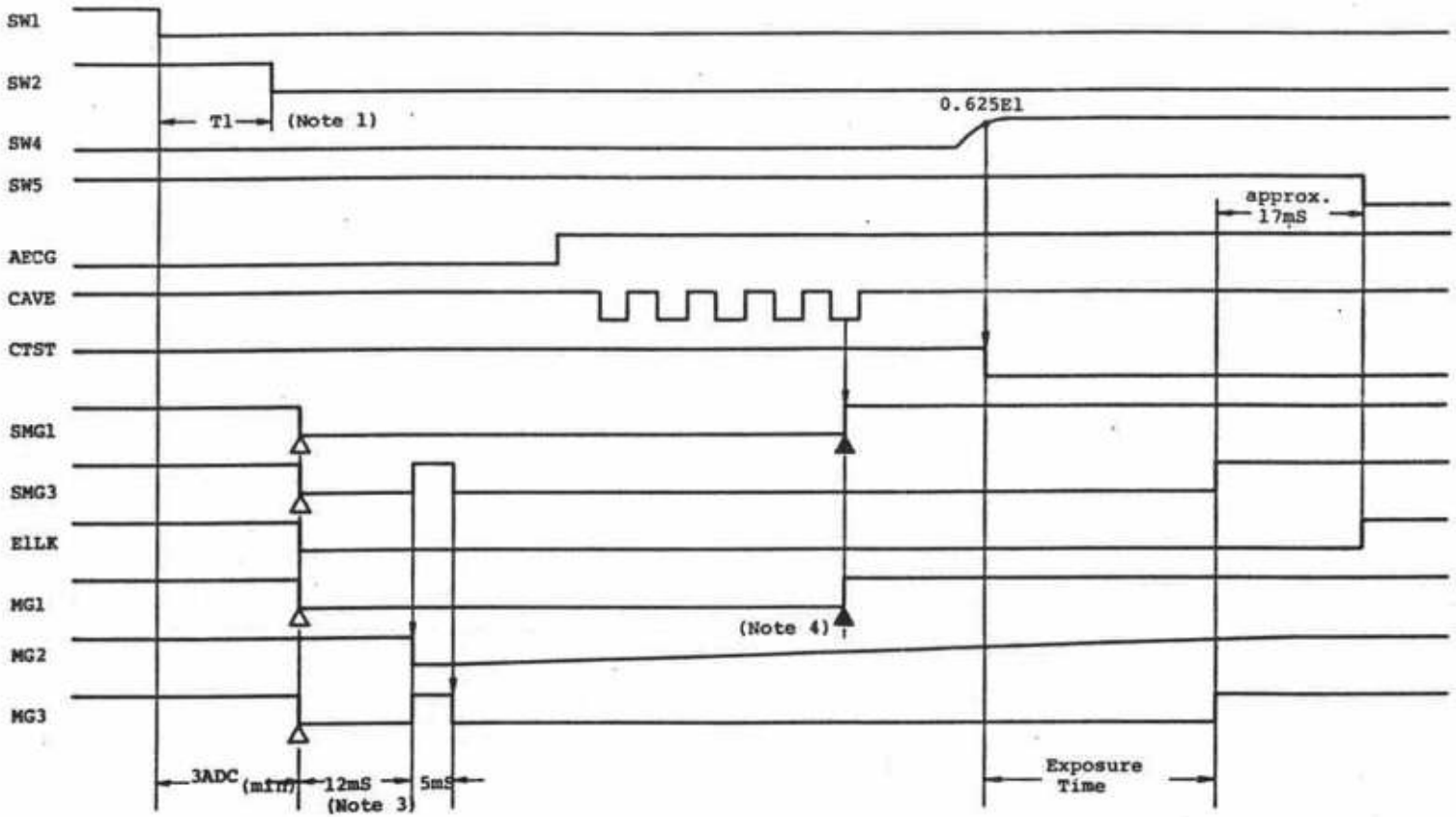
I BUS		EF-M	MODE 1	MODE 2	DISP GD	LV		ADCE
	BV 1/8	BV 1/4	BV 1/2	BV 1	BV 2	BV 4	BV 8	BV 16
O BUS	DISP M	DISP 2	DISP 3	DISP 4	DISP 5	DISP 6	DISP 7	DUMP
			TV 1/2	TV 1	TV 2	TV 4	TV 8	TV 16
	F	EEE	AV 1/2	AV 1	AV 2	AV 4	AV 8	BULB
T-B	0	1	2	3	4	5	6	7

	MODE 1	MODE 2
AE	0	0
BCK	0	1
EF-1	1	0
EF-2	1	1



7-2

Exposure Timing Chart



Note 1: T1 varies with the speed the shutter button is pressed.

Note 2: Mark
Initial operation mark parameters:
1. SW2 ON
2. SW5 OFF
3. $\overline{LV}$ (voltage OK)
4. $\overline{EEEE}$ (no error)
5. $\overline{SELF}$ (Self timer not set)

If self timer is set.

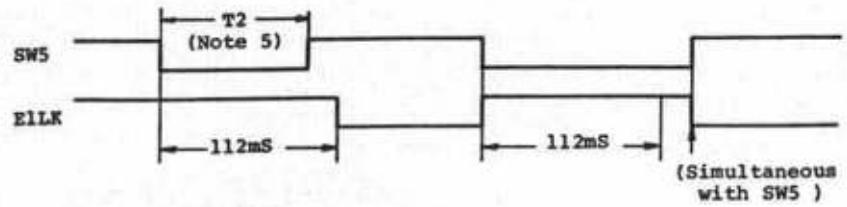
6. SELF LED END (self timer time is completeed)

Note 3: 12 mS delay is for exposure calculation and low voltage determination.

Note 4: Mark
Secondary Operation mark parameters:
1. SAVE SIGNAL present
2. $\overline{CTST}$ (Shutter count not started.
3. Lens at "A" mark

Note 5: T2 depends on the transport being used (PW A or MD MA) and its power level.

Continuous Operation
(SW1, SW2 ON continuously)



EV . BVO TABLE

This table list the BVO octal code at the Input IC's I BUS for all EV and AVO combinations.

(The lines near the top and bottom separate valid codes from those outside the meter coupling range).

EV \ AVO	1.2	1.4	1.8	2.0	2.5	2.8	3.5	4.0	4.5	5.6
-3	004	002	000							
-2	014	012	010	006	005	003				
-1	024	022	020	016	015	013	007	003		
0	034	032	030	026	025	023	017	013	007	003
1	044	042	040	036	035	033	027	023	017	013
2	054	052	050	046	045	043	037	033	027	023
3	064	062	060	056	055	053	047	043	037	033
4	074	072	070	066	065	063	057	053	047	043
5	104	102	100	076	075	073	067	063	057	053
6	114	112	110	106	105	103	077	073	067	063
7	124	122	120	116	115	113	107	103	077	073
8	134	132	130	126	125	123	117	113	107	103
9	144	142	140	136	135	133	127	123	117	113
10	154	152	150	146	145	143	137	133	127	123
11	164	162	160	156	155	153	147	143	137	133
12	174	172	170	166	165	163	157	153	147	143
13	204	202	200	176	175	173	167	163	157	153
14	214	212	210	206	205	203	177	173	167	163
15	224	222	220	216	215	213	207	203	177	173
16	234	232	230	226	225	223	217	213	207	203
17	244	242	240	236	235	233	227	223	217	213
18	254	252	250	246	245	243	237	233	227	223
19	264	262	260	256	255	253	247	243	237	233
20			270	266	265	263	257	253	247	243
21							267	263	257	253
22									267	263

(Threshold value for the BVO code is 007).

Code Example:

1 7 2

1 unit change equales 1/8 BV change.

1 unit change equales 1 BV change.

1 unit change equales 8 BV change.

Time	Grey Code					Octal Code*	Binary Code							
							1/8	1/4	1/2	1	2	4	8	16
B	0	0	0	1	0									
30"	0	0	1	1	0	034 040			1 0	1 0	1 0	0 1	0 0	0 0
15"	0	0	1	1	1	044 050			1 0	0 1	0 0	1 1	0 0	0 0
8"	0	0	1	0	1	054 060			1 0	1 0	0 1	1 1	0 0	0 0
4"	0	0	1	0	0	064 070			1 0	0 1	1 1	1 1	0 0	0 0
2"	0	1	1	0	0	074 100			1 0	1 0	1 0	1 0	0 1	0 0
1"	0	1	1	0	1	104 110			1 0	0 1	0 0	0 0	1 1	0 0
2	0	1	1	1	1	114 120			1 0	1 0	0 1	0 0	1 1	0 0
4	0	1	1	1	0	124 130			1 0	0 1	1 1	0 0	1 1	0 0
8	0	1	0	1	0	134 140			1 0	1 0	1 0	0 1	1 1	0 0
15	0	1	0	1	1	144 150			1 0	0 1	0 0	1 1	1 1	0 0
30	0	1	0	0	1	154 160			1 0	1 0	0 1	1 1	1 1	0 0
60	0	1	0	0	0	164 170			1 0	0 1	1 1	1 1	1 1	0 0
125	1	1	0	0	0	174 200			1 0	1 0	1 0	1 0	1 0	0 1
250	1	1	0	0	1	204 210			1 0	0 1	0 0	0 0	0 0	1 1
500	1	1	0	1	1	214 220			1 0	1 0	0 1	0 0	0 0	1 1
1000	1	1	0	1	0	224 230			1 0	0 1	1 1	0 0	0 0	1 1
P	1	1	1	1	0									
	2	3	4	5	6				2	3	4	5	6	7
	T • B								T • B					

TB 7(SSLC) : 0

* : Lower octal code in each box is code for preset shutter speed.

1 : Switch Close

0 : Switch Open

CODES: All codes in this Repair Guide read with the least significant digit on the left (T.B 0) and the most significant digit (T.B 7) on the right. This is the order of the oscilliscope and bus checker tool.

AV CODE

Aperture	Grey Code					Octal Code	Binary Code							
							1/8	1/4	1/2	1	2	4	8	16
1.2	0	0	0	1	0	014	0	0	1	1	0	0	0	0
1.4	0	0	1	1	0	020	0	0	0	0	1	0	0	0
1.8	0	0	1	1	1	024	0	0	1	0	1	0	0	0
2.0	0	0	1	0	1	030	0	0	0	1	1	0	0	0
2.5	0	0	1	0	0	034	0	0	1	1	1	0	0	0
2.8	0	1	1	0	0	040	0	0	0	0	0	1	0	0
3.5	0	1	1	0	1	044	0	0	1	0	0	1	0	0
4.0	0	1	1	1	1	050	0	0	0	1	0	1	0	0
4.5	0	1	1	1	0	054	0	0	1	1	0	1	0	0
5.6	0	1	0	1	0	060	0	0	0	0	1	1	0	0
6.7	0	1	0	1	1	064	0	0	1	0	1	1	0	0
8.0	0	1	0	0	1	070	0	0	0	1	1	1	0	0
9.5	0	1	0	0	0	074	0	0	1	1	1	1	0	0
11	1	1	0	0	0	100	0	0	0	0	0	0	1	0
13	1	1	0	0	1	104	0	0	1	0	0	0	1	0
16	1	1	0	1	1	110	0	0	0	1	0	0	1	0
19	1	1	0	1	0	114	0	0	1	1	0	0	1	0
22	1	1	1	1	0	120	0	0	0	0	1	0	1	0
27						124	0	0	1	0	1	0	1	0
32						130	0	0	0	1	1	0	1	0
	2	3	4	5	6				2	3	4	5	6	
	T • B								T • B					

TB 7 (SSLC) : 1

1 : Switch Close

0 : Switeh Open

AVO , AVC CODES

AVO / AVC	Grey Code				Octal Code	
					AVO	AVC
1.2	0	0	1	0	014	013
1.4	0	1	1	0	020	011
1.8	0	1	1	1	024	007
2.0	0	1	0	1	030	005
2.5	0	1	0	0	034	002
2.8	1	1	0	0	040	0
3.5	1	1	0	1	044	0
4.0	1	1	1	1	050	0
4.5	1	1	1	0	054	0
5.6	1	0	1	0	060	0
	3	4	5	6		
	T • B					

ASA	Grey Code						Octal Code
6	0	0	0	0	0	1	0 0 0
	0	0	0	0	0	0	0 0 3
	0	0	0	0	1	0	0 0 5
12	0	0	0	1	1	0	0 1 0
	0	0	0	1	1	1	0 1 3
	0	0	0	1	0	1	0 1 5
25	0	0	1	1	0	1	0 2 0
	0	0	1	1	0	0	0 2 3
	0	0	1	1	1	0	0 2 5
50	0	0	1	0	1	0	0 3 0
	0	0	1	0	1	1	0 3 3
	0	0	1	0	0	1	0 3 5
100	0	1	1	0	0	1	0 4 0
	0	1	1	0	0	0	0 4 3
	0	1	1	0	1	0	0 4 5
200	0	1	1	1	1	0	0 5 0
	0	1	1	1	1	1	0 5 3
	0	1	1	1	0	1	0 5 5
400	0	1	0	1	0	1	0 6 0
	0	1	0	1	0	0	0 6 3
	0	1	0	1	1	0	0 6 5
800	0	1	0	0	1	0	0 7 0
	0	1	0	0	1	1	0 7 3
	0	1	0	0	0	1	0 7 5
1600	1	1	0	0	0	1	1 0 0
	1	1	0	0	0	0	1 0 3
	1	1	0	0	1	0	1 0 5
3200	1	1	0	1	1	0	1 1 0
	1	1	0	1	1	1	1 1 3
	1	1	0	1	0	1	1 1 5
6400	1	1	1	1	0	1	1 2 0
	1	1	1	1	0	0	1 2 3
	1	1	1	1	1	0	1 2 5
12800	1	1	1	0	1	0	1 3 0
	2	3	4	5	6	7	
	T • B						

1 : Switch Close

0 : Switch Open

CNTL

C N T L	Grey Code			
A (Main SW)	—	—	0	0
Self Timer 2	—	—	0	1
Self Timer 10	—	—	1	1
Manual	—	1	—	—
Auto	—	0	—	—
Stopped-down	1	—	—	—
Open Aperture	0	—	—	—
	3	4	5	6
	T • B			

priority (SSLC) (A/T Dial)

S S L C	Grey Code
AV AE	1
TV AE	0
	7
	T•B

1. Disassembly

1.1 AT Dial

1. Set the AT dial guard in the up (guard) position.

2. Screw CA1-1086
3. Slider and Slider Cover* CA1-1062 & CA1-0975

3. Slide both parts down together to remove them.

4. Steel Ball XG8-1100-571
5. Screw (2 ea.) X18-1702-580
6. Click Base CF1-0273

7. Bracket CA1-1064

1.2 Winding Lever

1. Pin Face Screw CA1-0965
2. Washer X98-0604-190-200

3. Spring Washer CS1-7078
4. Washer CA1-0966
5. Winding Lever CF1-0269

6. Winding Lever Seat CF1-0250
7. C Ring CA1-0935

8. Washer (N ea.) X98-0604-150 thru -170
9. CNTS Lever CA1-0932

10. ME Lever CA1-0930

1.3 Shutter Button

1. Shutter Button Assy. CG9-0062
2. Washer X98-0903-810-820

3. Washer CA1-1126
4. Washer (N ea.) X98-0903-810-820
5. A/T Change Lever CA1-0960

1.4 Rewind Crank

1. Rewind Crank Unit CG9-0051
2. Rubber Collar CA1-5121
3. Stopper CA1-5125

4. G Ring CA1-4959
5. ASA Plate CS1-8153
6. ASA Lock Plate CA1-0986

7. ASA Dial
CG9-0049

1.5 Top Cover

1. Eyepieces Screw Cover
CA1-1009

2. Screw
X91-1430-070

3. Eyepiece Shutter Lever
CA1-1008

4. Screw (4 ea.)
X91-1736-360

5. Front Cover Unit
CG9-0056

6. Turn the viewfinder information switch ON. (The switch should be on when removing or attaching the top cover to prevent bending the switch contacts.

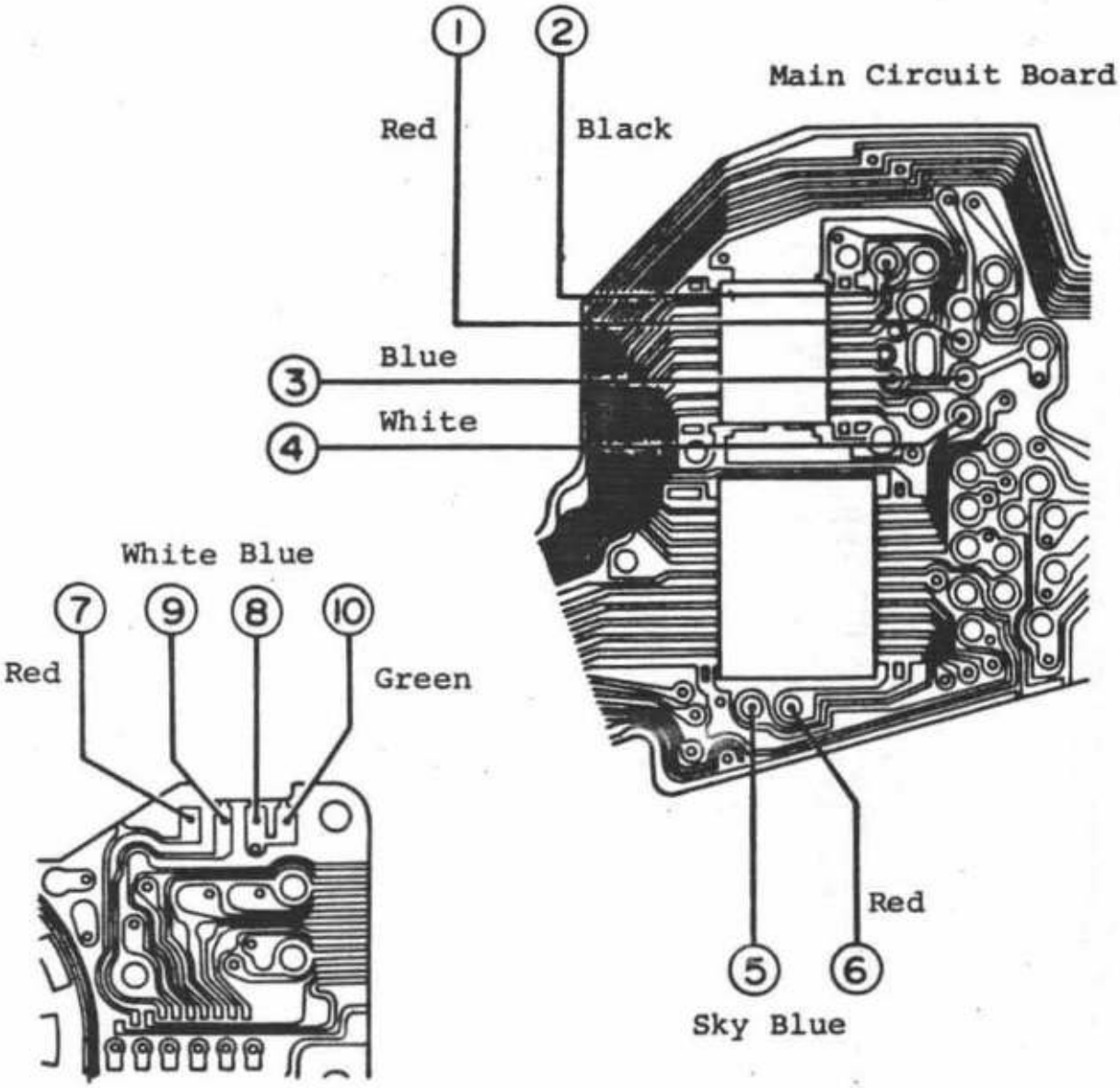
7. Screw (6 ea.)
X91-1736-360

8. Top Cover Unit
CG9-0048

1.6 Base Cover

1. Screw (2 ea.)
X94-1701-110

2. Base Cover W/Coupling Cover
CA1-0905 & CA1-4707



1.7 Front Panel Unit

1. Lead Disconnection

Disconnect the leads shown above. The origin of each lead is shown here for reference.

1. Red. (Mgl +)	2. Black (Mgl -)
3. Blue (LM SW)	4. White (AELK)
5. Sky Blue (AECG)	6. Red (SAVE)
7. Red (SPDW)	8. Blue (SPDW)

9. White (A-M Change Switch)
10. Green (A-M Change Switch)

2. Connectors

11.	Screw X91-1736-310	12.	Shoulder Screw** CA1-1083
13.	SAVE Connector CF1-0287	14.	Screw (2 ea.) X91-1736-560
15.	D/D Connector B CF1-0264	16.	Rubber Band CA1-1140

**: Only loosen the shoulder screw. Do not remove it. (If the screw is removed the bottom half of the Connector (CA1-1037) will be loose under the circuit board.)

3. Front Panel Unit

16.	Leather (R) CA1-1079	17.	Leather (L) CA1-1112
18.	Screw (2 ea.) X95-2000-440	19.	Screw (3 ea.) XA1-3200-809
20.	Shoulder Screw CA1-5012	21.	Front Panel Unit NPN

*: 1. The front panel unit can be removed with the pentaprism and D/D flexible circuit board attached.

2. When removing the front panel unit, the SAVE flex is pulled out from under the main flex.

3. When the front panel unit is reinstalled, the D/D flex connector may hit a capacitor on the bottom of the D/A board. Insure that the D/D flex connector passes under the capacitor.

4. When installing the front panel unit, make sure that the X sync (red) lead passes over the top of the pentaprism.

2. Reassembly and Adjustment

Reassembly is normally the reverse of disassembly. This guide contains reassembly details which may not be obvious and all necessary adjustment. The AE-1 Repair guide also contains usefull information.

2.1 Spool Torque

1. Spool Gear (CG9-0056-000) is installed from the bottom of the body.

2. Align the ear of the spring with the groove in the spool.

3. Spool Torque: 165 ~ 190 gcm.

   Adj: Change spool gear
   (The plate spring is a part of the Spool Gear unit (CG9-0056-000).

4. Alternate Spool Torque Check

   Spool torque may be checked by wrapping a string around the spool and checking the tension required to turn the spool.

   Spool Tension: 254 ~ 292 g. (Spool Dia: 13 mm)

   Note: Take care to use the correct tolerance for the type of test used.

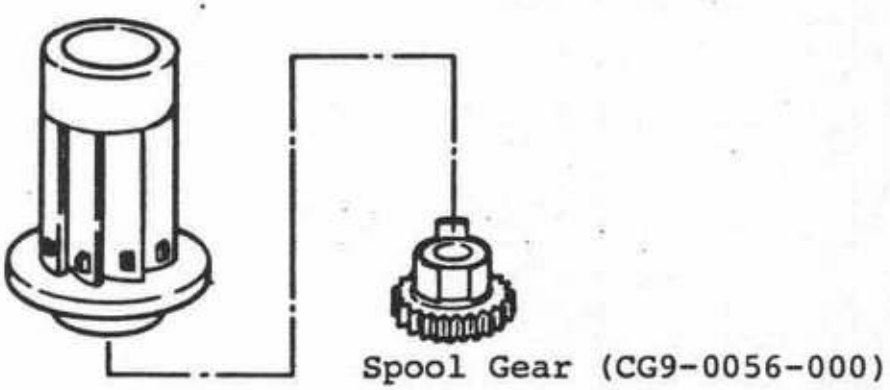


Fig. 2-1

2.2 Shutter Unit Installation Adjustment

1. Count Switch SW 4 "OFF" position Adjustment

   The count switch should go "OFF" at L = 0.1 ~ 0.3 mm from its position when the first curtain starts its travel. (Fig. 2-2.)

   Adjustment: Count Switch eccentric screw.

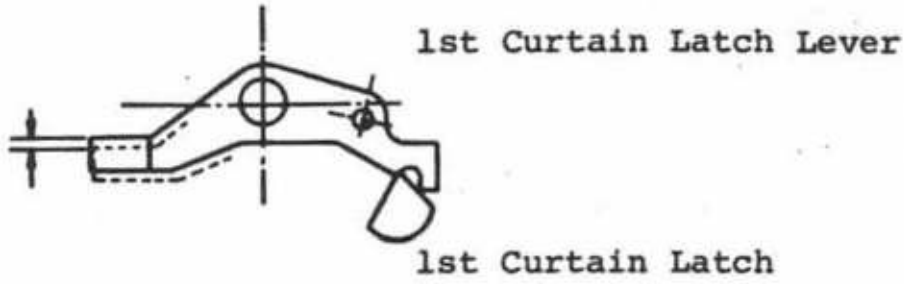


Fig. 2-2

2. 2nd Curtain Latch Charge Torque

With the shutter wound the force required to move the tip of the spring (at F1) should be 170 to 190 grams. (Measure where the spring just starts to move). (Fig. 2-3)

3. 2nd Curtain Latch Lever Release Torque

The force required to separate the armature from the yoke by pushing at F2 should be 60 ± 5 g. (Measure where they just separate).

Adjustment: Change spring

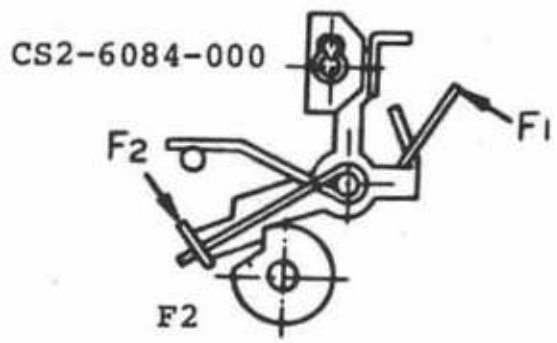


Fig. 2-3

4. 2nd Curtain Latch Set Position

1. Wind the shutter

2. L_{ℓ} = 0.3 ~ 0.5 mm. (When the armature is against the yoke.)

Adjustment: Instalation position of the yoke.

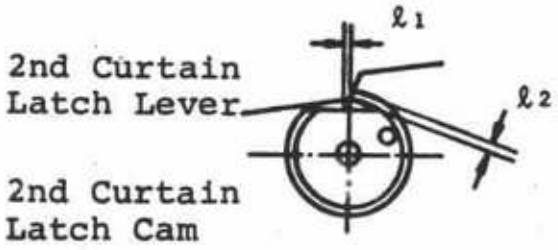


Fig. 2-4

3. With the shutter would L_2 = 0.0 ~ (-0.15) mm (under charge)

   Adjustment: Setscrews (X31-6222-590) x 2

   Notes: 1. Remember that this adjustment is different from the AE-1.
   This mechanism differe from the AE-1 in that the latch cam and latch lever are in hard contact (pushing against each other) in the A-1.
   In the AE-1 there is a slight clearance between them in the shutter wound position.

   2. If this adjustment is not correct the middle shutter speeds will not be correct.

2.3 Shutter Speed Adjustment

1. The shutter speeds of this camera are all automatically controlled by the computer, using the clock pulse as the standard. The shutter speed adjustment is made by adjusting the count start (CTST) signal timing. (Section 3.3.2.)

2. Set the camera in the TV mode and the shutter speed to 1/1000. Check the shutter accuracy.

3. Adjust VRT for the most accurate shutter speed. (Fig. 2-5)

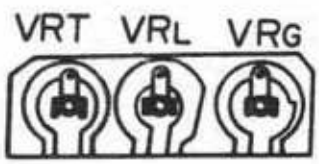


Fig. 2-5

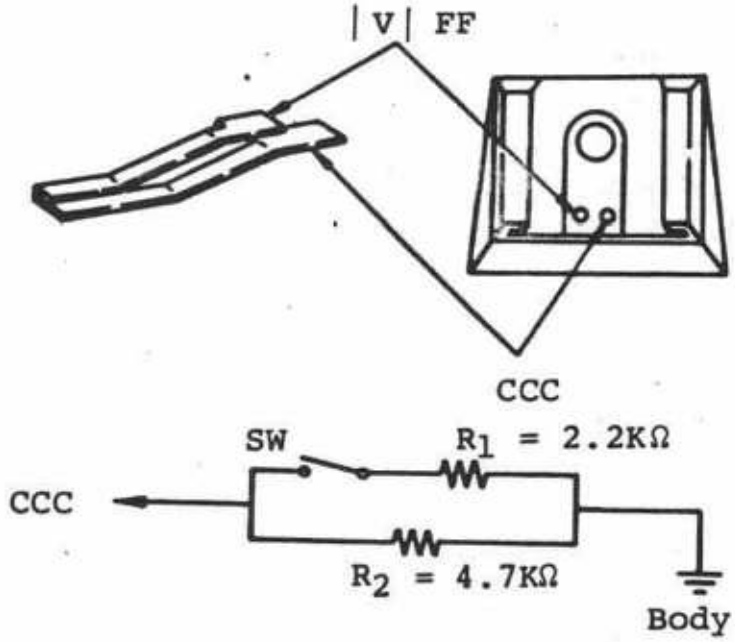


Fig. 2-6

2. X Sync Timelag

Shutter Tester

Line A: 0.5 ms or over

Line B: 2.0 ms or over

Contact Efficiency: at 1/60 sec, 70% + (1 ms contact)

Adjustment: Bend X contact

3. X Contact - Safety Contact Timing

During winding the x contact should never make and the safety contact should be on before winding is complete.

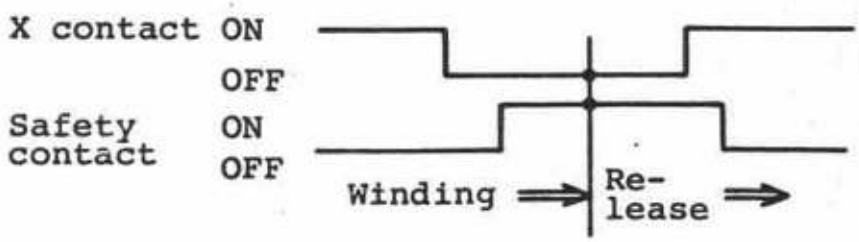


Fig. 2-7

4. Check to see that all shutter speeds are within tolerances.

2.4 Flash (X) Synchronization

1. Check shutter speed.

   1) When using the 155A or the 199A in the automatic shutter setting mode*, the shutter speed is automatically set to 1/60 at all AV settings and all TV settings except B.

   2) When using the 199A in the manual shutter setting mode* the shutter speeds will be:

      A. AV mode: 1/60 sec.

      B. TV mode:

         With dial set between 1/1000 ~ 1/60: 1/60 sec

         With dial set between 1/30 ~ 30": Selected speed

         With dial at B: Bulb

   3) Programmed Mode: 1/60 sec.

   4) If the speedlites are not available, the kludge (hand made test device) shown here may be used to simulate them. Closing the switch simulated the 199A's manual shutter setting mode.

---

*: The 199A has a switch located on the top of the main body under the flash head. This switch is marked" "AUTO MANU 1/60 ~ 30S". In the AUTO mode the camera is automatically switched to 1/60s, just as the AE-1. In the MANU mode and with the camera in TV mode, shutter speeds lower than 1/60 can be selected to bring out dark backgrounds, etc.

2.5 Mirror Bounce Brevention Lever

1. The force required to just start the mirror bounce prevention lever, applied at "F" in figure 2-8 should be between 10 and 20 grams. It is adjusted by changing the jump prevention Spring (CS1-6109-000)

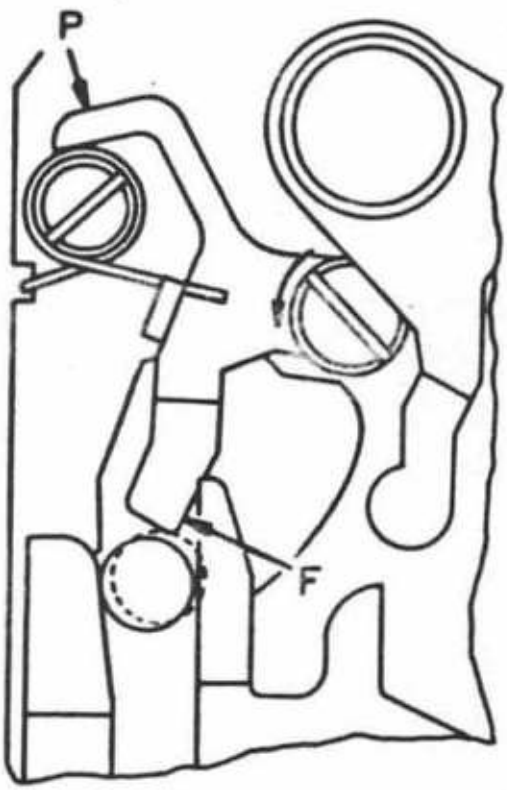
2. Bounce Prevention Lever Overcharge Adjustment

   1) Install the front panel unit on the universal 90° colimator.

   2) Push the lever as far as possible in the "P" direction and hold it.

   3) The mirror angle should change 16' to 48' from the normal position. (Fig. 2-8)

Adjustment: Eccentric Screw A



Mirror bounce prevention lever spring.

Eccentric Screw A

Mirror bounce prevention level

Fig. 2-8

Note: Improper adjustment may cause instability of the viewfinder display at the end of each shutter operation.

2.6 Flush Pattern Position Adjustment

1. Set the AVO brush at P1 - P1'. (Fig. 2-9)

2. Check between all points "a thru e" (detail A). There should be continuity between all points a thru e.

   Adjustment: Flush pattern position

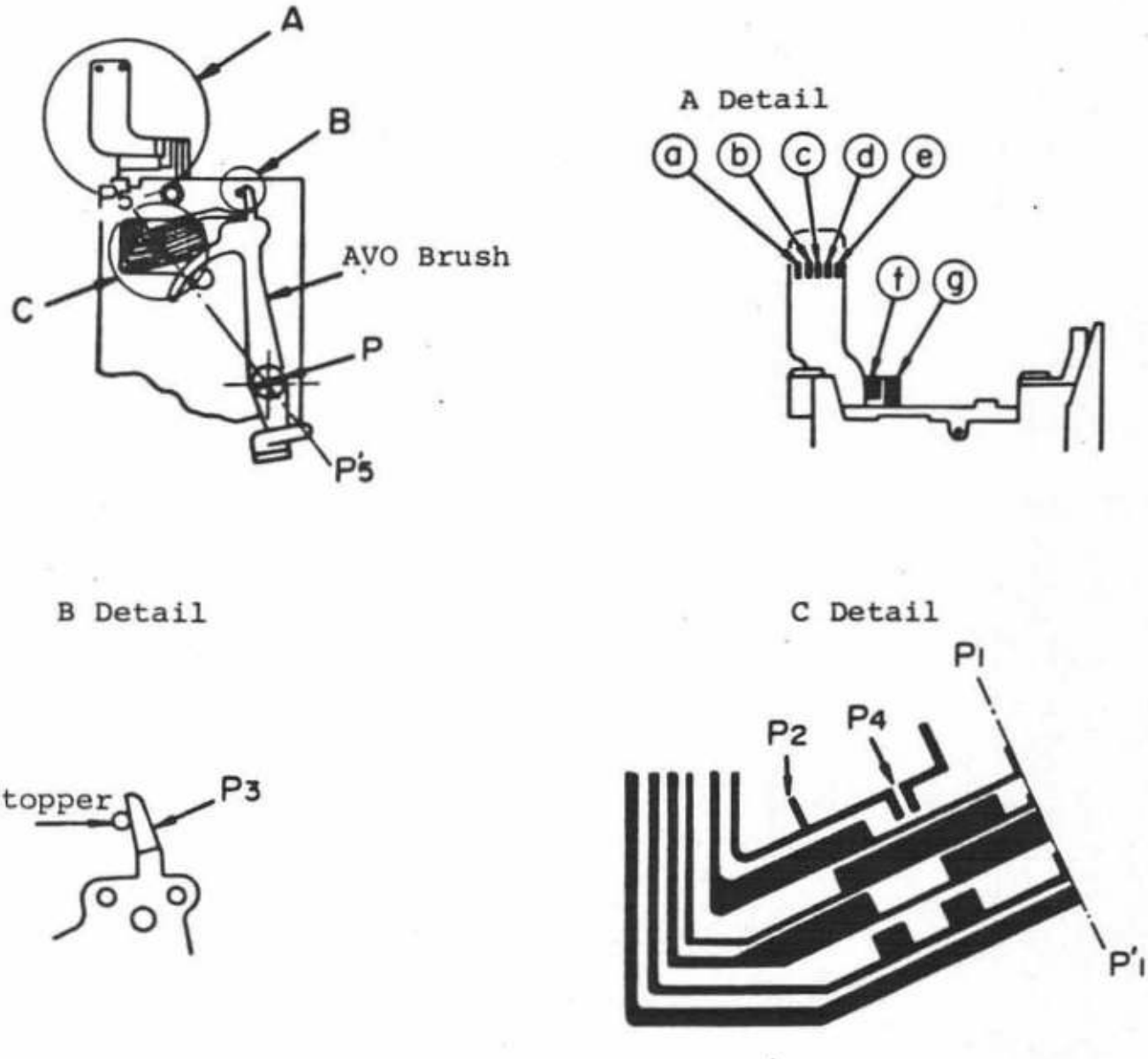


Fig. 2-9

2.7 AVO Brush Stopper Position (f/5.6 maximum aperture position)

1. Position the AVO brush against its stopper (Fig. 2-9, Detail B).

2. The contact part of the brush should be at P2 and the other contact points should form line P5-P5'.

   Adjustment: Bend the stopper striker (P3) portion of the brush.

Note: Check that the finder information flash when an f/5.6 lens is mounted and the brightness is below the f/5.6 level.

2.8 Maximum Aperture Signal Pin Adjustment (Front Panel Only)

Precautions: Adjustment of the pin has a direct effect on the viewfinder display. It must be adjusted correctly.
If the pin is to be adjusted with this procedure the flange focal distance (FFD) should be adjusted before the front panel is removed.

1. Two ohmmeters are necessary for this test. They should both be set on low OHM scales. Place the plus (+) lead of meter A on "f" and the minus (-) on "a" (Fig. 2-9).

2. Place the + lead of meter B on "g" and the - lead on "a" (also Fig. 2-9).

3. Using a depth gage, slowly depress the maximum aperture correction pin.

4. As the depth gage is depressed, meter A will show a closed circuit and meter B will show an open. At a certain point meter A will swing back toward ∞ and B will still be at ∞. Slightly farther down, B will swing toward O.

5. At the point where both meters are at ∞, the pin should be 7.59 ±0.03mm below the mount surface.
(This point where both meters are at ∞ is marked P4 on detail C of 2-9).

2.9 Maximum Aperture Singal Pin Adjustment (Assembled Camera)

1. Set the camera in TV at 1/1000 second.

2. Set the depth gage to 7.62mm and set it against the pin. The aperture number "1.8" should be flashing in the viewfinder.

3. Reset the gage to 7.56mm and repeat. "2.0" should be flashing in the viewfinder. In both step 2 and 3, excess light should be kept out of the lens mount.

4. Adjust the pin height till the conditions detailed above are met.

   (The relaxed position of the pin should be approximately 5.5 to 5.7mm below the mount surface.)

2.10 Maximum Aperture Signal Pin Code

The code output from the max. aperture signal pin should be as shown in the table below (Fig. 2-10).

AVO		5.6	4.5	4.0	3.5	2.8	2.5	2.0	1.8	1.4	1.2
Pin height ±0.05 (mm)		5.70	6.00	6.30	6.57	6.90	7.15	7.46	7.72	8.10	8.38
a - e	4	1	1	1	1	1	0	0	0	0	0
a - d	2	0	1	1	1	1	1	1	1	1	0
a - c	1	1	1	1	0	0	0	0	1	1	1
a - b	1/2	0	0	1	1	0	0	1	1	0	0

Note: "1" indicates continuity (near 0Ω); 0 indicates an open circuit (∞).

Fig. 2-10

2.11 AV Brush Position (AE Charge (AECG) Position)

Precautions:

1. This adjustment not only affects exposure accuracy. It also has an effect on the total AE operation in that incorrect positioning will lock the shutter and light the error mark (EEEE EE). Take care to make the adjustment correctly.

2) The AE Start Lever position and Aperture

Signal Lever overcharge should be adjusted before making this adjustment. See the AE-1 Repair Guide (1976) section 2.28 and 2.29 for these adjustment.

1. Mount an FD 50mm 1:1.4 lens.

2. Charge the mechanism so the AE charge latch rest on the first (upper) step of the AE charge lever. (Fig. 2-11)

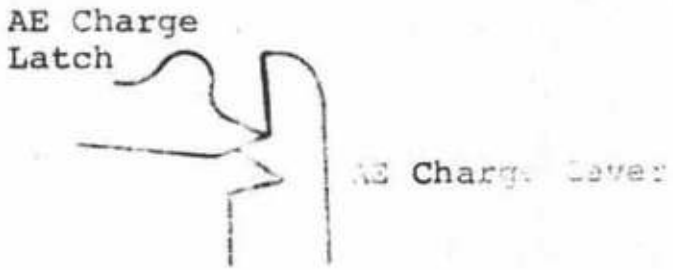


Fig. 2-11

3. Put an ohmmeter from screw "A" to the Test Point. (Fig. 2-12).

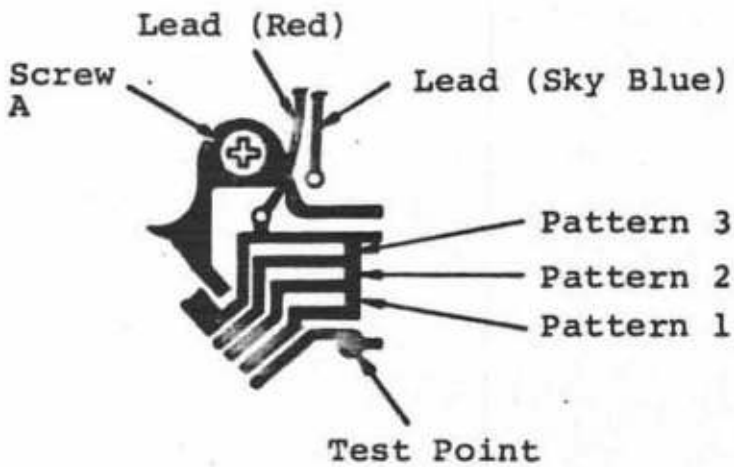


Fig. 2-12

4. In this condition (step 1, 2) check that the AV brush is on the check bit position. (In this case the check point is a space in the pattern.)

The lateral position on the brush should be as shown in figure 2-13.

Note: The ohmmeter should be at ∞ when the brush is at the check bit and near zero ohms with a slight movement in either direction.

Adjustment: AV Brush mounting position.

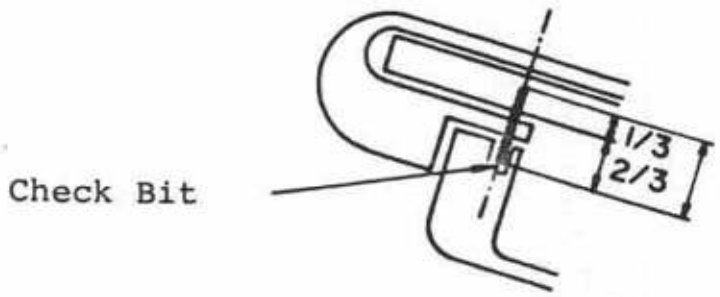


Fig. 2-13

2.12 Compound Gears Installation

1. Lube shaft and gears as shown in the lubrication chart. Lube: Lozoid 72090

2. Mesh the pawl of Compound Gear-II (CF1-0230-000) in the notch of Compound Gear-I.

3. Install as indicated in figure 2-14.

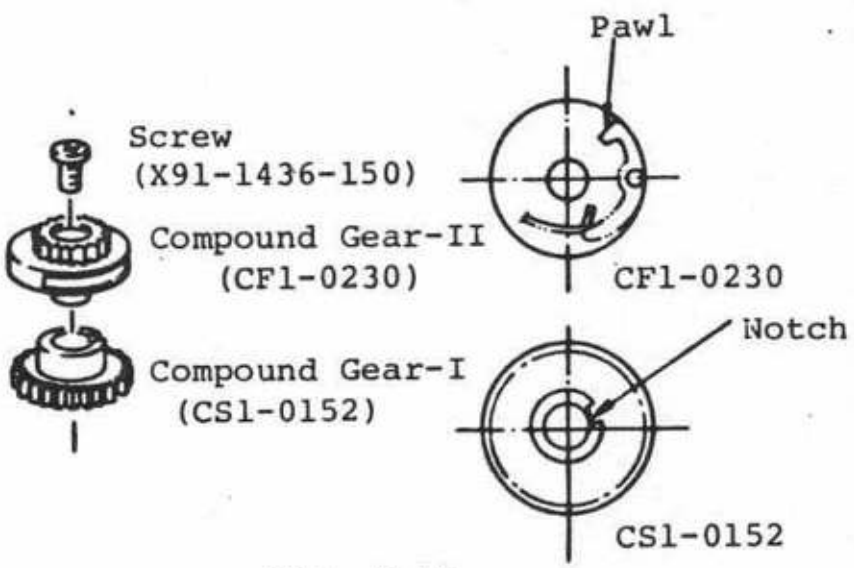


Fig. 2-14

2-13 Preliminary Perforation Position

Note: The final perforation positioning adjustment is performed when the charge gear is installed (Section 2.15, 2.16).

1. Align the center of the riveted dowel on compound gear-II with the scribed line on the Winding Base.

   (CF1-0231-000) as shown in figure 2-15. The limit is ±1/2 the dowel diameter.

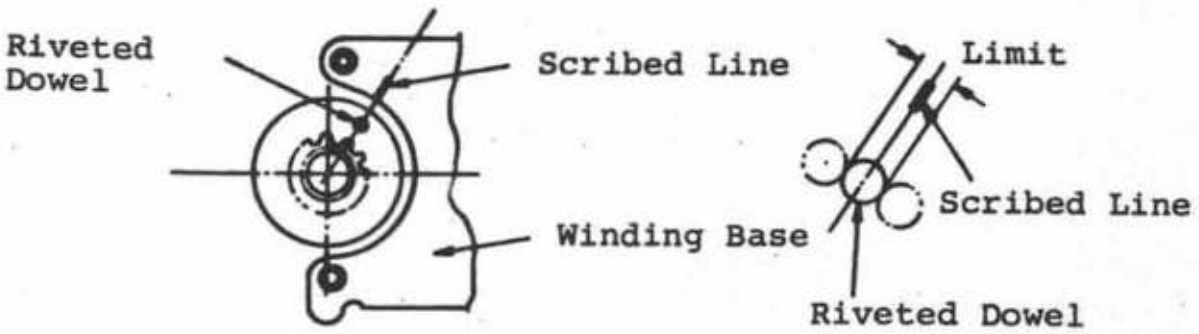


Fig. 2-15

2. To adjust, change the mesh of the sprocket gear with relation to the compound gear-II. (Change the sprocket gear, not the compound gear.

   Notes: 1) To move the perforations toward the spool end, change the mesh one or two teeth in the spool direction. (For a slight change, change the mesh by four teeth.)

   2) To move in the cartridge end direction, reverse the above procedures.

   3) When correctly positioned, the sprocket gear will be approximately as shown in Fig. 2-16.

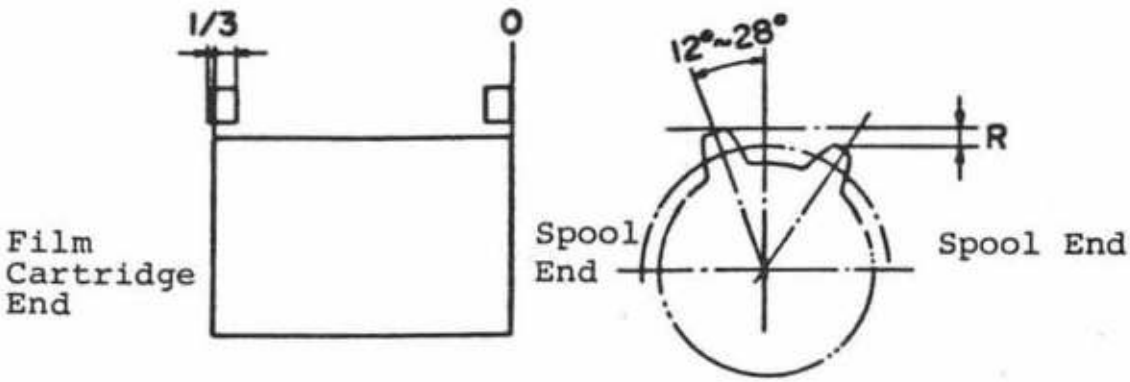


Fig. 2-16

2.14 Winding Shaft Installation

1. Set the mechanism in the charged condition.
2. Lube the points marked A, B, and C with Lozoid 72090.
3. Install the 17 Steel Balls (14-4498-000) which make up the bearing.
4. Mesh one of the wide teeth on the winding shaft with the plain area on the intermediate Idler Gear (CS2-0364-000) as shown in figure 2-17.

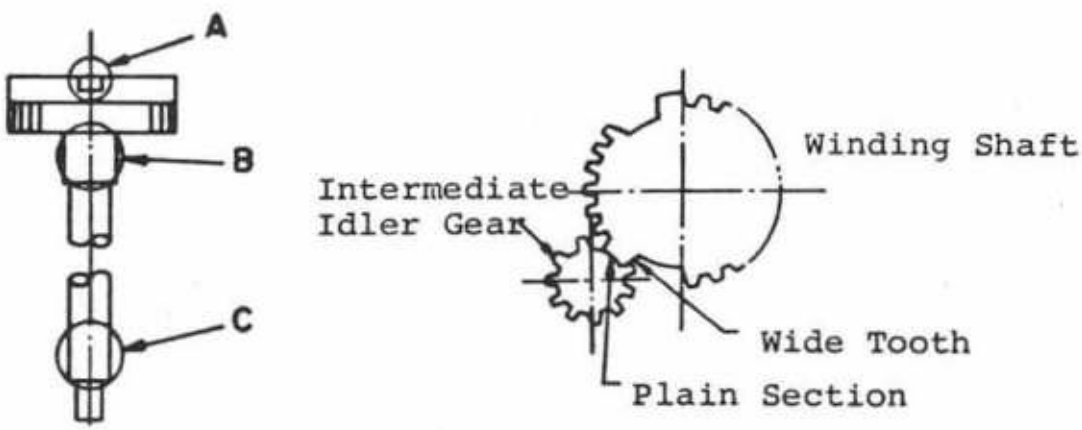


Fig. 2-17

5. The mesh should be so that the flat section of the end of the winding shaft is perpendicular to the centerline of the camera body. (Fig. 2-18)

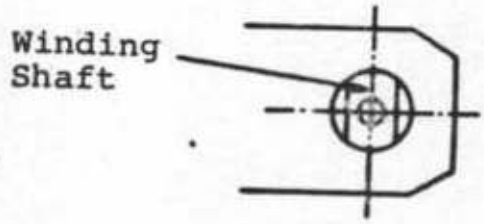


Fig. 2-18

2.15 Charge Gear Installation

1. Install the parts as shown in figure 2-19.

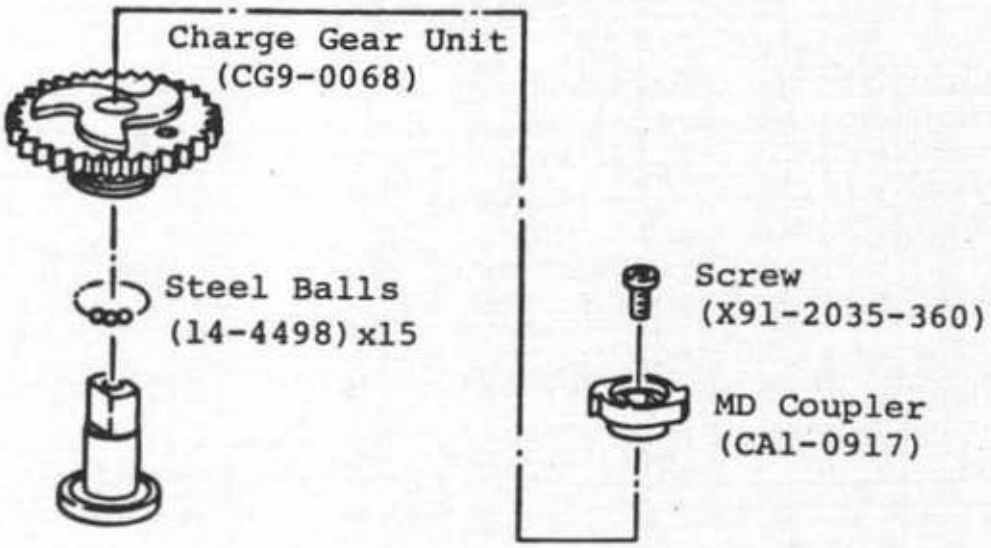


Fig. 2-19

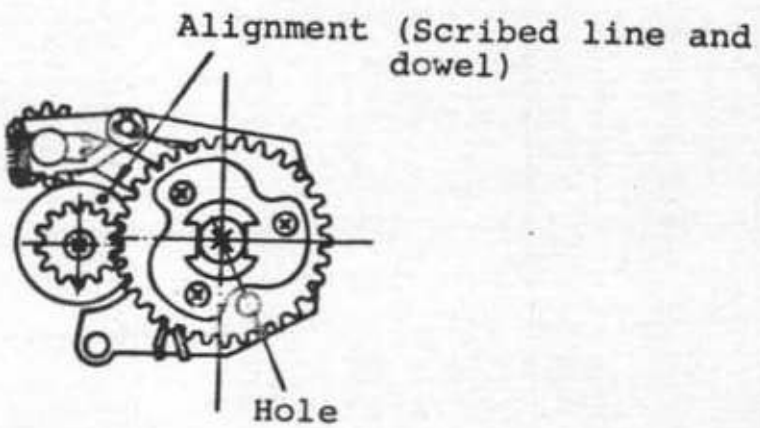


Fig. 2-20

2. Recheck the alignment of the dowel and scribed mark detailed in section 2.13 (Fig. 2-15) after having installed the charge gear with the screw access hole positioned as shown in figure 2-20. Adjust to maintain the position by selecting a charge gear that gives the correct alignment.

2.16 Perforation Adjustment (Final)

Note: Perform this adjustment after installing the charge gear.

1. Install a strip of test film, wind enough to secure it on the spool and then wind and hold the winding lever at the maximum.

2. Pull back on the other end of the film (about 200g) to pull the film taunt.

3. The perforation position should be as shown in figure 2-16. Readjust, if necessary, as stated in section 2.13.2.

Note: If this adjustment is not correct, the multiple exposure (ME) lever will not engage.

2.17 SW5-SW5' Adjustment

Caution: If this adjustment is not correct, there is a possibility that the camera will not function.

1. Wind the camera.

2. Set the brush so that it is on the check pattern. (Fig. 2-21) Adjustment: Eccentric Screw A

3. Release the shutter

4. Recheck the brush position. At least four segments of the brush should be on each of the switch patterns. (Fig. 2-21) Adjustment: Eccentric Screw A

5. Recheck steps 2 and 4. Switch condition should not change even at the extremes of play in the brush at each position.

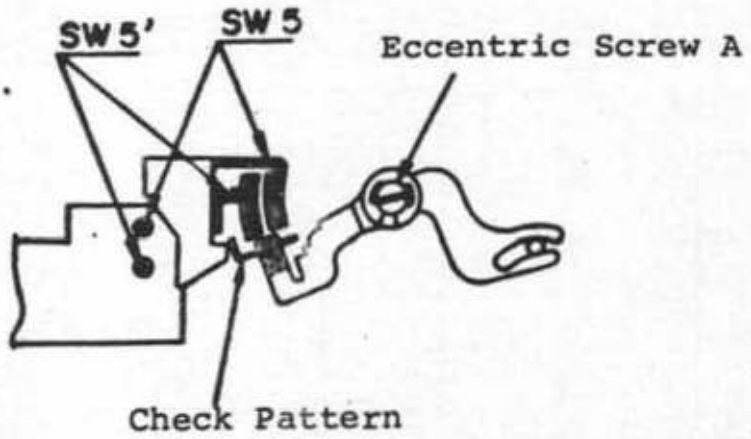


Fig. 2-21

2.18 A/T Dial Base Assembly

1. Assemble the parts as shown in figures 2-22 thru 2-24.

Note: Align "1000" on the A/T Indicator (CS1-8154-000) with the mark on the A/T Dial (CF1-0245-000), (Fig. 2-23)

Install the LED with the leads placed as shown in figure 2-24.

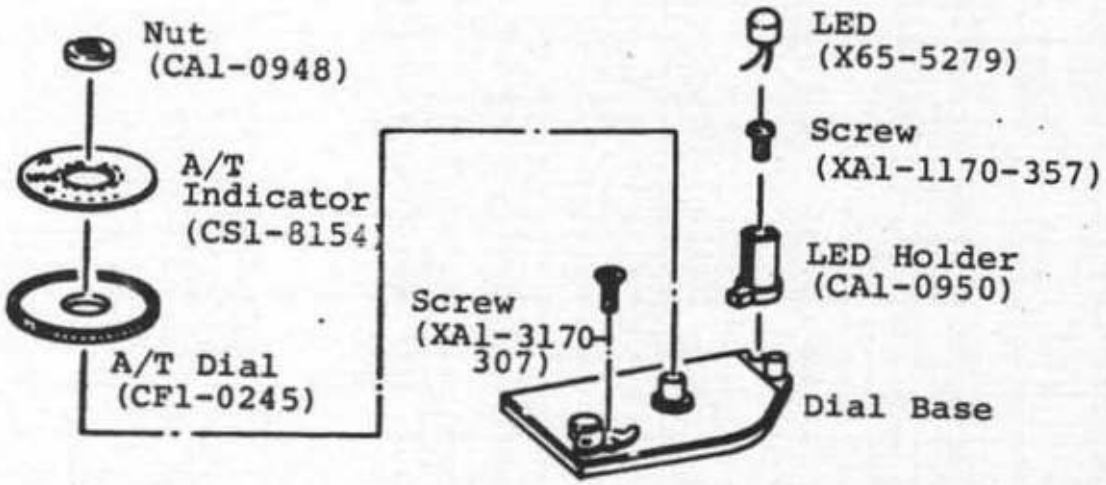


Fig. 2-22

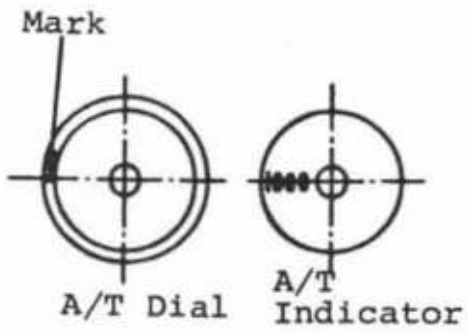


Fig. 2-23

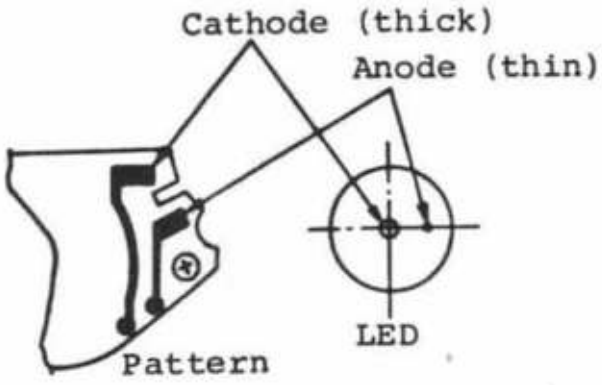


Fig. 2-24

2.19 Multiple Exposure (ME) Lever Adjustment

1. Wind the camera.
2. Install the parts as shown in figure 2-25.
3. Set the ME Coupler (CF1-0240-000) in the detent activated position.
4. With the ME mechanism set as described in step 3, it should be possible to push the winding reset lever in the "A" direction as shown in figure 2-26.
5. Wind the camera halfway and stop.
6. In this condition it should be possible to move the ME coupler a considerable amount in the setting direction but not enough to set the detent.
7. Adjust step 4 and step 6 with the eccentric screw shown in figure 2-26.

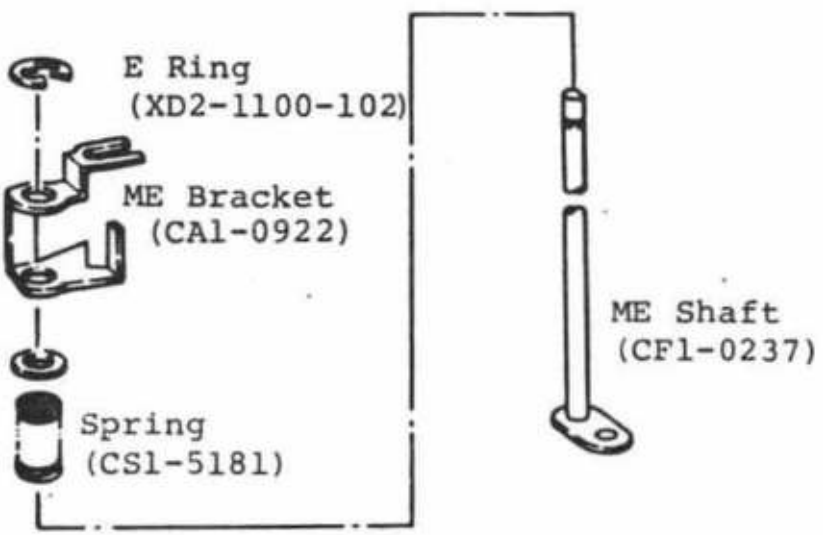


Fig. 2-25

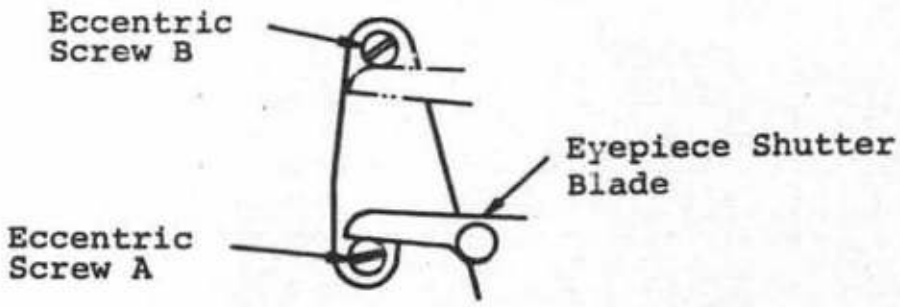


Fig. 2-26

2.20 Eyepiece Shutter Adjustment

1. Set the eyepiece shutter to the open position.
2. There should be no play in the blades in the open position. Adjust with Eccentric Screw "A" (Fig. 2-27).
3. Close the eyepiece shutter.
4. There should be no play in the blades in the closed position. Adjust with Eccentric Screw "B" (Fig. 2-27).

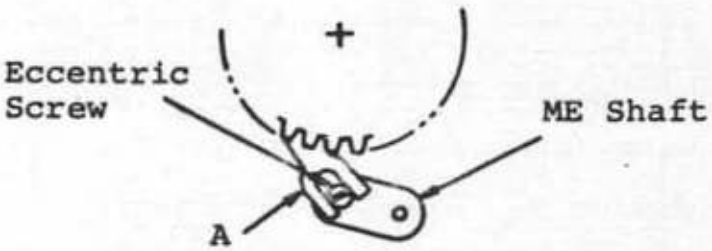


Fig. 2-27

2.21 SPC Output Adjustment

1. Mount a FD 50mm 1:1.4 Lens.
2. Attach test leads to the I BUS, CLK and SYNC (D7) test pads on the ridge of the main flex over the pentaprism. (Fig. 2-28)

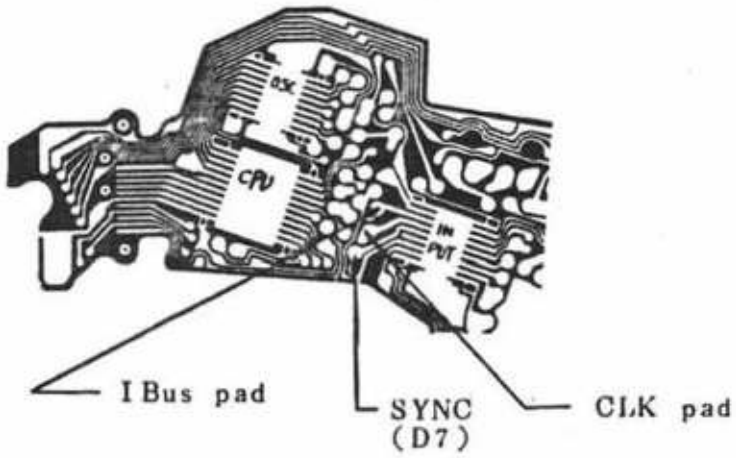


Fig. 2-28

3. Attach the test leads to the proper terminals on the Bus Checker. (See the Bus Checker instructions also.)

4. Using a light source adjusted to the birghtnesses shown in the chart below, adjust the output of the SPC (BVO octal code). (See the EV-BVO code Table)

K = 125

EV	Brightness (cd/m^2 or nt)	SPC OUTPUT Center	(BVO Code) Limits	Adjustment	Adjustment Interaction
9	64	142	136-146	VRG	
12	512	172	166-176	VRG, VRL	
15	4096	222	216-226	VRL	

Fig. 2-29

Notes: 1. The SPC output (BVO) is independent of the settings of the ASA or A/T dials.

2. Shield the SPC from extraneous light. Any light other than that coming thru the lens will change the adjustment.

3. The viewfinder display has no effect on the adjustment.

4. Lube Spring (CS1-5181-000) with LT-SH.

2.22 ASA Brush Adjustment

1. This adjustment is made with the top cover in place.

   The SV Check Bit Tool -1S is used.

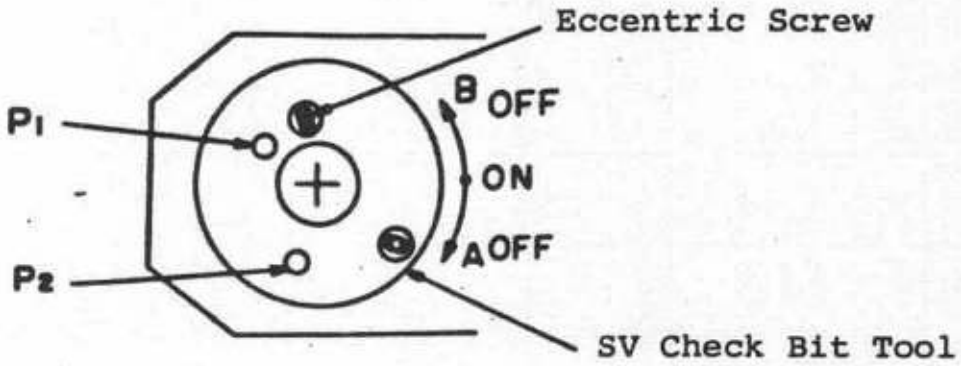


Fig. 2-30

2. Place the ohmmeter leads into holes P1 and P2. The ohmmeter should be set to a low range. (An analog ohmmeter is easier to read than a digital meter).

3. Holding the leads against the pattern under the bit and moving the tool as far as possible in the A and B directions, the meter should indicate an open circuit at both ends and continuity in the center.

4. Adjust with the eccentric screw so the OFF (∞), ON (0Ω), OFF (∞) condition is met.

   Note: This adjustment affects exposure accuracy. Readjust if the top cover or the ASA Contact is changed.

   Refer to the tools instructions for the SV Check Bit-1S.

2.23 Diaphragm Accuracy Check

This adjustment checks the accuracy of the programmed control of the lens diaphragm in the aperture priority mode. A special tool lens is used to perform this adjustment where it is available, but it can be performed with an oridnary FD 50 mm 1:1.4 with a well calibrated diaphragm.

Note: When using an ordinary lens, the shutter speed

accuracy must have been previously confirmed, as well as the accuracy of the EV tester.

1. Set the camera in the AV mode.

2. Set the A/T dial to f/2, f/5.6 and f/11 and release the shutter and read the scale on the AE Evaluation Standard lens. (Disregard this step when using the alternate method.)

3. Check the exposure value at f/2, f/5.6 and f/11. (Read the exposure value as closely as possible. This test involves adjusts in 1/8EV increments.)

4. If the EV tester indicates slight over exposure, correction can be made by opening the pattern at point 1(and point 2 if necessary) in figure 2-12. (Opening one point on the pattern causes a shift of 1/8 EV under. No over adjustment is provided.)

Note: This adjustment is necessary if electrical components are changed.

Poor operation of Mg.1 may cause large variations in this test.

Viewfinder Indications should be disregarded.

2.24 Viewfinder Display Adjustment

Adjustment of individual digits within the display is not possible. Limited adjustment of the display unit is possible to correct positioning or tilt within the mask. Adjustment is made by loosening the two Screws (X16-1701-880) holding the DD Flex Unit. The display is an intergal part of the flex unit.

2.25 Focusing Screen Replacement

1. The focusing screen is replaceable simply by removing one screw. Remove the lens and Screw (X18-1702-280) from the focusing screen Holder (CF1-0280-000). When the holder is removed the Focusing Screen Holder (CF1-0257-000), which is hinged at the rear, will drop down from the front and the focusing screen can be removed.

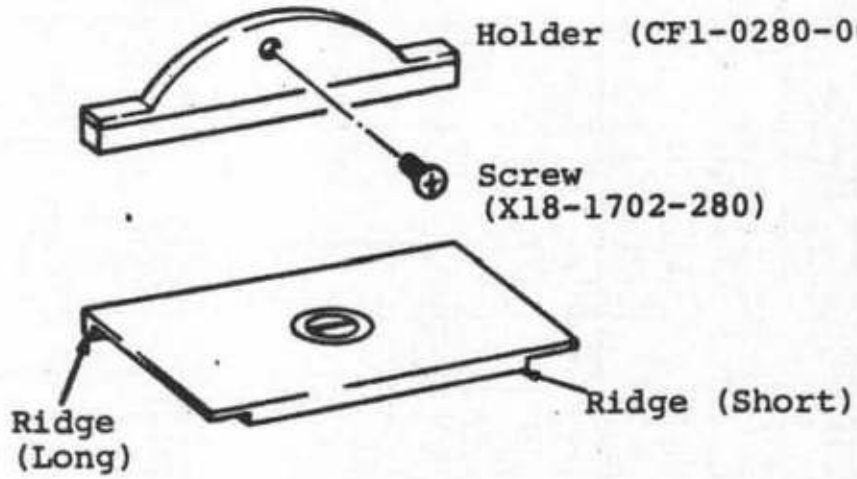


Fig. 2-31

Notes: 1. The frensel lens is on the lower surface of the focusing screen. (This surface has ridges on the front and rear edges. The rear ridge is the longer of the two.

2. When the focusing screen is changed, check the focus and exposure.

2.26 Pentaprism

1. Install the pentaprism with the parts shown below. (Fig. 2-32)

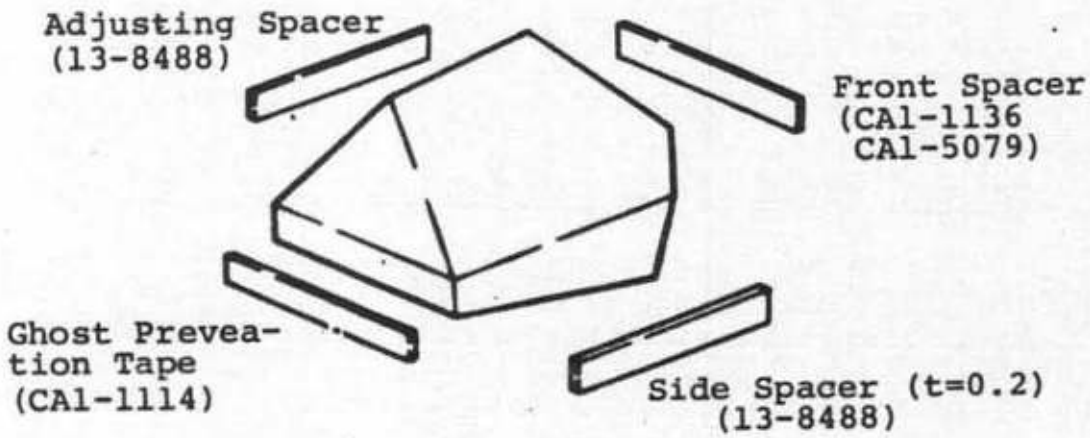


Fig. 2-32

2. Install the prism toward the rear and right (winding) sides.

3. Run light shield (Toray Silicon SC5002 Black) between the prism, spacers and frame so that it covers completely to block light leaks. Apply on all sides except the rear (eyepiece) side. (Fig. 2-33)

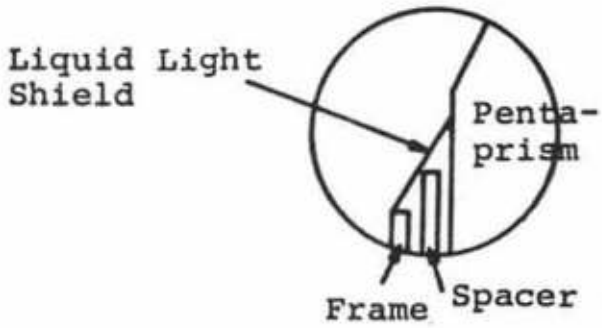


Fig. 2-33

2.27 Viewfinder Mask Installation

1. Install the mask so that the narrow side is to the right (winding side).

2. Press the mask toward the standard surfaces. (Fig. 2-34)

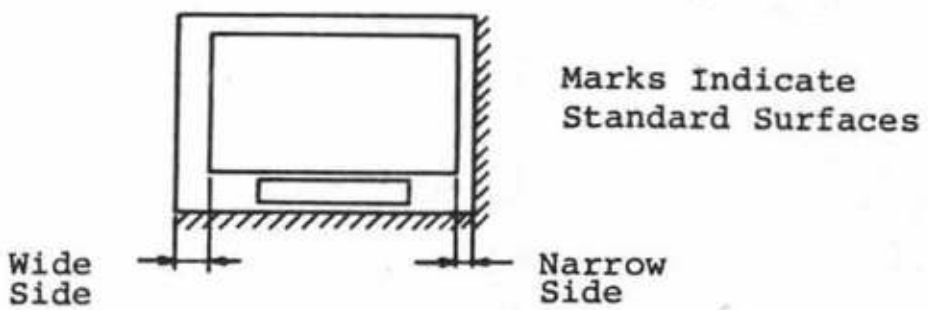
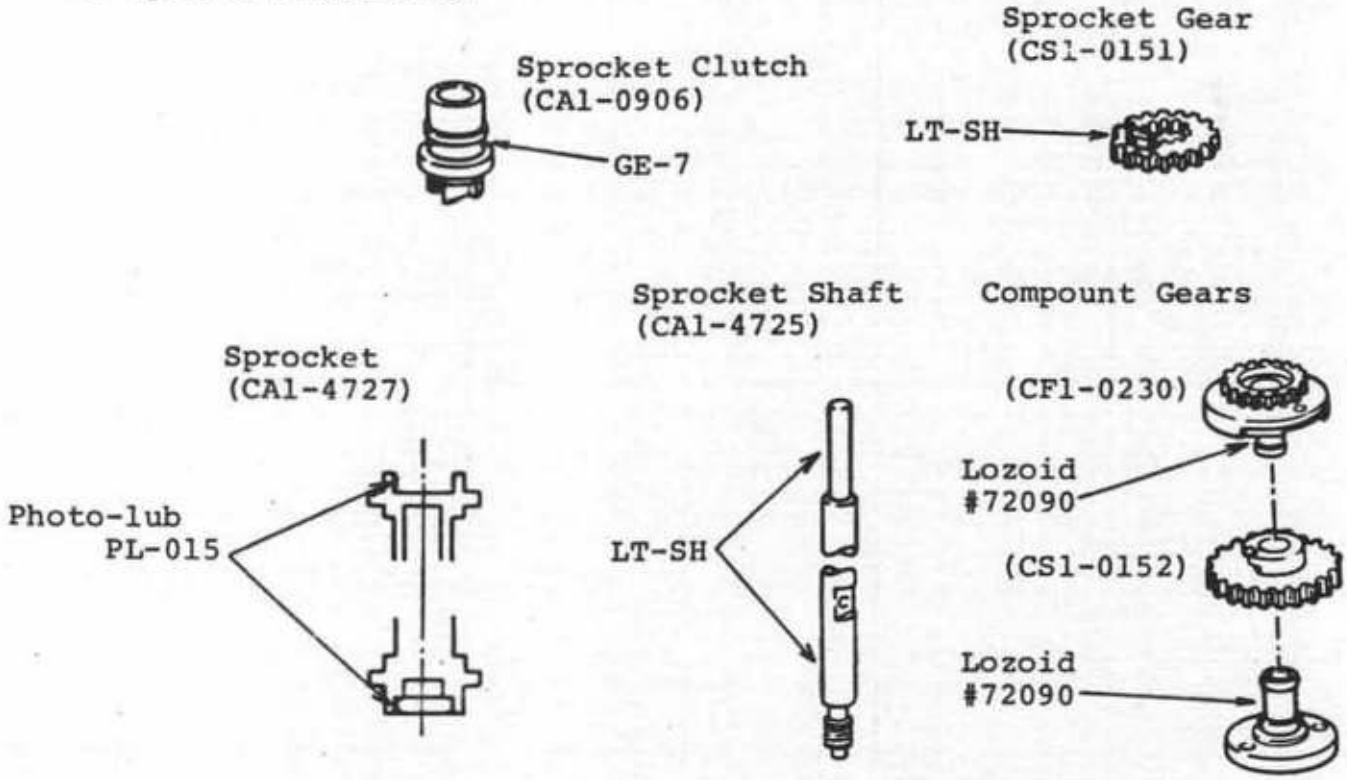


Fig. 2-34

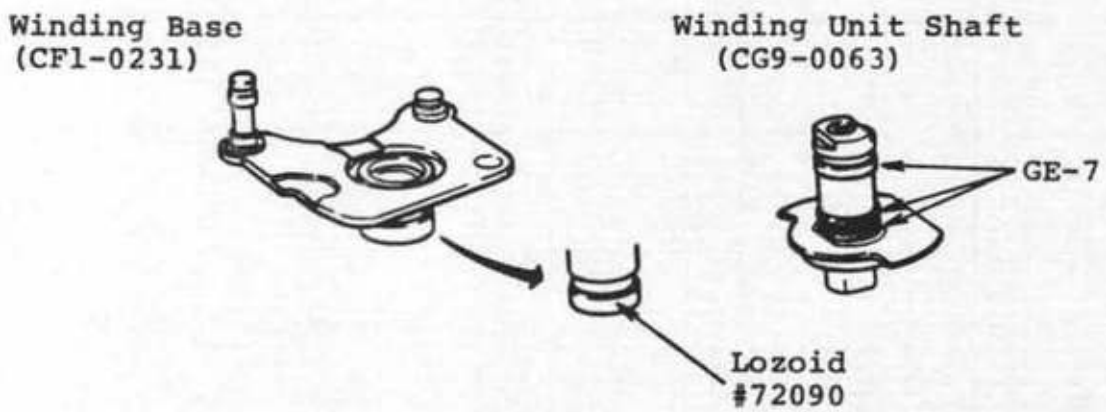
2.28. Body Parts Lubrication

1. Sprocket Mechanism



2. Spool Mechanism

3. Wind / Rewind Mechanism



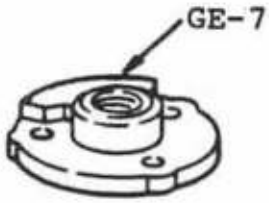
Spring
(CS1-6101)

Lozoid
#72090

Charge Gear Cam
(CG9-0068)

Lozoid
#72090

Tripod Socket
(CA1-4708)



GE-7

Winding Lever
(CF1-0269)

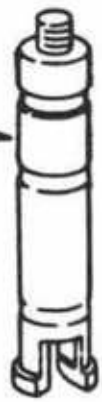
Photo-lub
PL-015

Winding Shaft
(CF1-0236)

Lozoid
#72090

Rewind Shaft
(CA1-0981)

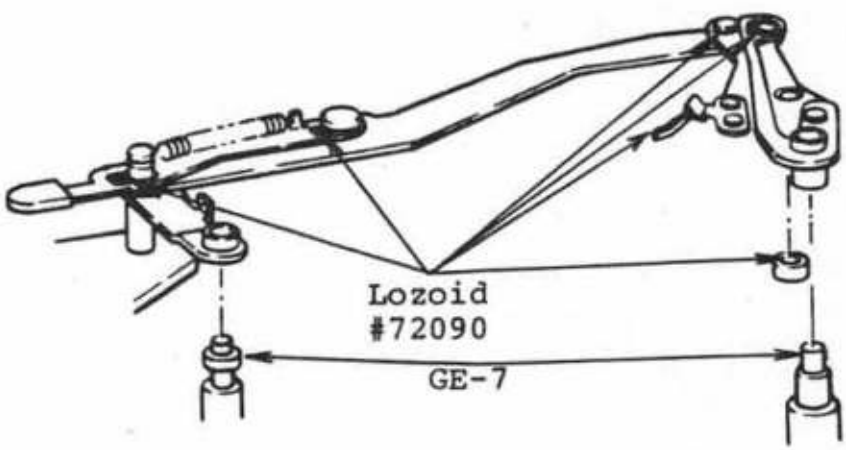
GE-7



Rewind Crank
(NS)

Photo-lub
PL-015

Connecting Lever Unit
(CG9-0094)



Lozoid
#72090

GE-7

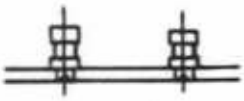
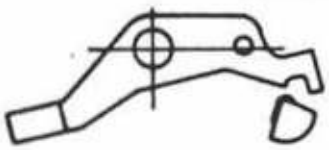
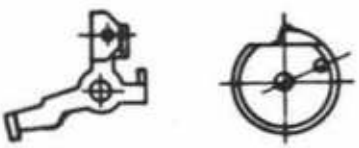
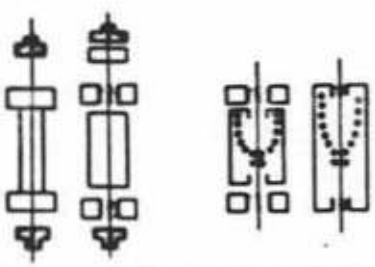
4. Miscelleanous

CNTL Coupler
(CF1-0239)

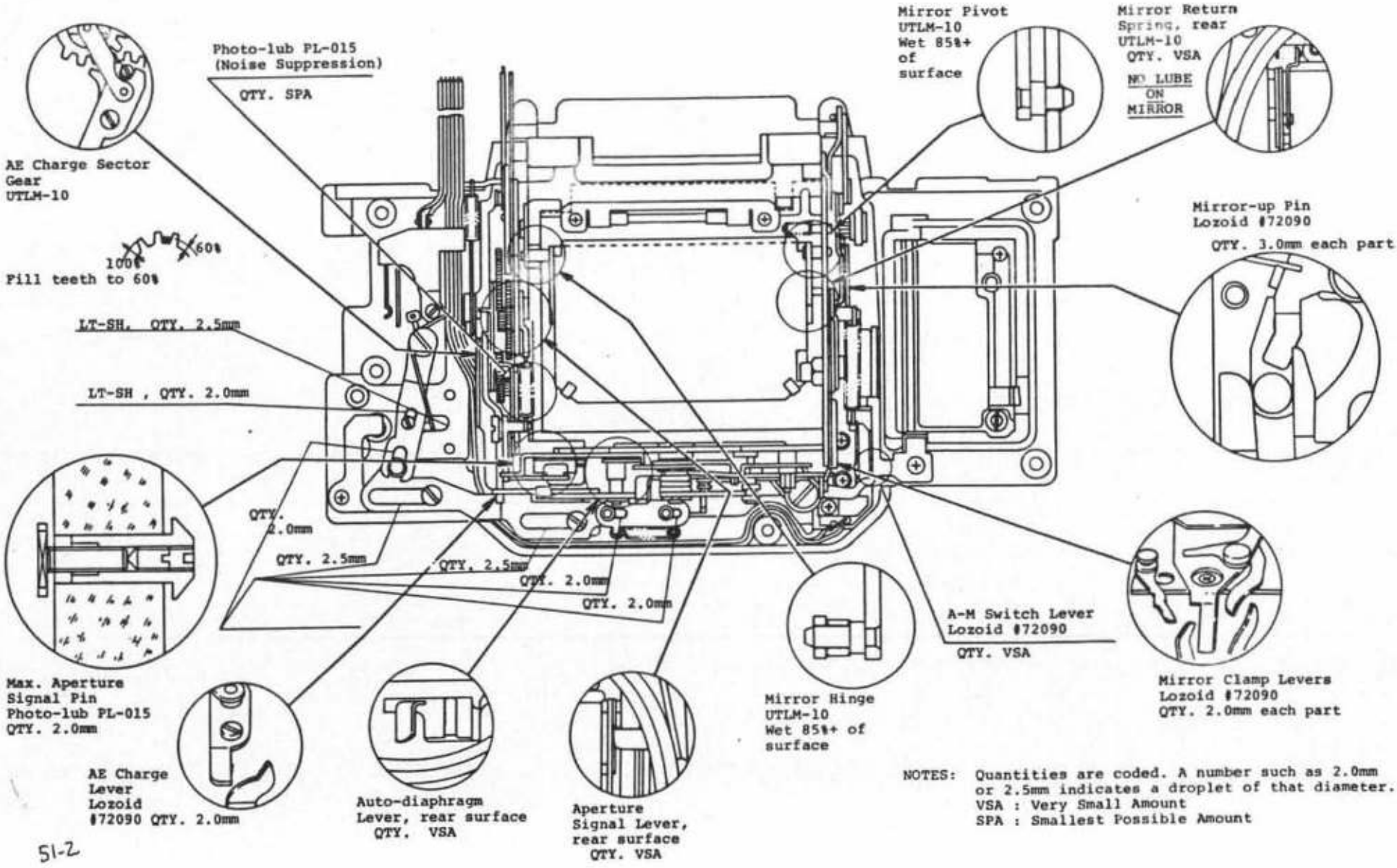
ME Coupler
(CF1-0240)

Steel Balls : Lozoid #72090

2.29. Shutter Unit Lubrication

Lube Point	Illustration	Lubricant	Remarks
Idler Gear Shafts		Astro-oil + GE-7	Mix 2 : 1
Master Shaft & Gear Bushings		Astro-oil	
1st Curtain		Astro-oil	
1st Curtain		Astro-oil	
2nd Curtain		Astro-oil	
2nd Curtain Latch & Cam		Astro-oil	
1st , 2nd Curtain Brakes		Low-temp EP	
Winding Stopper Shaft		Low-temp EP	
Drum Collars Shaft Bushing Pinion Shaft Bushing		Astro-oil	
Release Lever		Low-temp EP	

2.30. Front Panel Unit Lubrication Chart



NOTES: Quantities are coded. A number such as 2.0mm or 2.5mm indicates a droplet of that diameter.
VSA : Very Small Amount
SPA : Smallest Possible Amount

51-2

3. Circuit Operation (Signals and Waveforms)

The A-1 electronic circuit is very complicated in principle, but, in actual practice, if the inputs and outputs from each IC pin are known most problems can be readily understood.

This section of the Repair Guide list the singals present at each pin (or leg) of each IC. Illustrations of oscilloscope waveforms and codes shown on the BUS CHECKER (Tools Instruction No. F-050E) are given, as well as voltage levels, possible problems and other useful notes. A low voltage power supply set at five volts was used for all test.

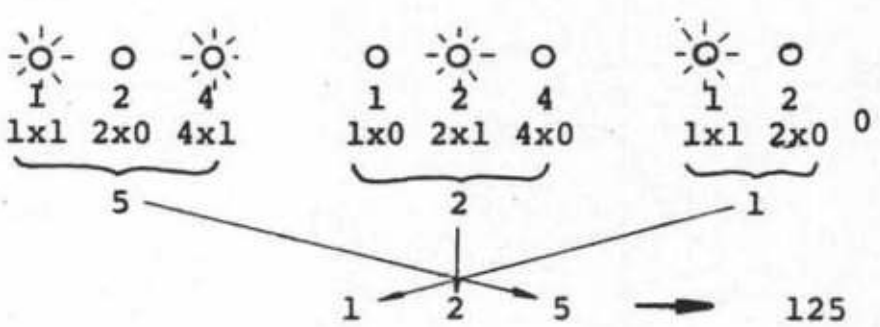
Almost all signals depend on the timing of the synchronization trigger (SYNC (D7)). See section 3.3.17 to check it.

Notes: Oscilloscope displays and the Bus Checker both have the least significant digit (LSD) at the left and the most significant digit (MSD) at the right. The time base (TB) position numbers indicate the power to which the radix 2 is raised. For this reason, the binary code is converted to octal code as illustrated in the example below.

All measurable data is presented in "active low" configuration. In other words, the ground, or lower, level is a "1" and the higher level is a "0". It is necessary to remember this when reading waveforms on the oscilloscope.

Ghowing LED's shall be read as "1" and dark LED's shall be read as "0". The LED's are grouped from the left side in groups of three LEDs, three LEDs, and two LEDs. Read the code "1" or "0" according to which LED's are lit, respectively, and the numeral indicated below each LED, then, find total figures from each group to obtain a three digit figure comprising one each numeral of each of three groups, and reverse the order of the numerals as illustrated in the following diagram.

Sample case



3.1 OPT IC (SN28724)

The operation of this IC is practically identical to PX-1 in the AE-1. Refer to the AE-1 Repair Guide for individual pin outputs.

3.2 INPUT IC (SN28721)

1. |V| EF (11p)* *(11p) = pin 11

Input pin for the flash originated signal which determines the aperture to which the lens will be set in AE flash mode (EF mode) (Signal is present only when CCC curent is flowing)

(225 - 275 μA + shutter |V| EF = VC(5/4 - AV/16) 1/60: 720 - 880μA = slow shutter speed manual mode)

V1 = VC + VC/16 f/2.8

V2 = VC f/4.0

V3 = VC - VC/16 f/5.6

Fig. 3-1

2. CCC (12p)

Identical in principle to CCC and VC in AE-1, this signal automatically switchs the shutter speed to 1/60 when the flash is ready. The A-1 VC is 1.219V ± 35mV.

In addition, the A-1 has a slow shutter speed manual mode when used with the SPEEDLITE 199A. The currents for automatic and manual shutter speeds are as follows.

I1 = 250μA ± 10% (Shutter Speed = 1/60, 155A & 199A Auto)

I2 = 800μA ± 10% (A/T Dial 1/1000 - 1/60; AV mode
Shutter Speed = 1/60

A/T Dial 1/30 - 30;
Shutter Speed = Dialed speed)*

*: For 199A in Slow Shutter Speed Manual Mode

3. I BUS (13P)

This is the information output from the Input IC to the CPU. It contains brightness (BV), low voltage interlock (LV) and mode information (AE, BCK, EF-1, EF-2, EF-M) and display (DISP) information. I BUS stands for Input Busline which is the time sharing input bus to the CPU. The busline carries information in two words (one word = 8 bits). Word 1 is brightness code and Word 2 is mode information.

T·B(0)	T·B(1)	T·B(2)	T·B(3)	T·B(4)	T·B(5)	T·B(6)	T·B(7)
BV(1/8)	BV(1/4)	BV(1/2)	BV(1)	BV(2)	BV(4)	BV(8)	BV(16)
	EF-M	MODE 1	MODE 2	DISP GO	LV		ADCE

	MODE 1	MODE 2
AE	0	0
BCK	0	1
EF-1	1	0
EF-2	1	1

Fig. 3-2

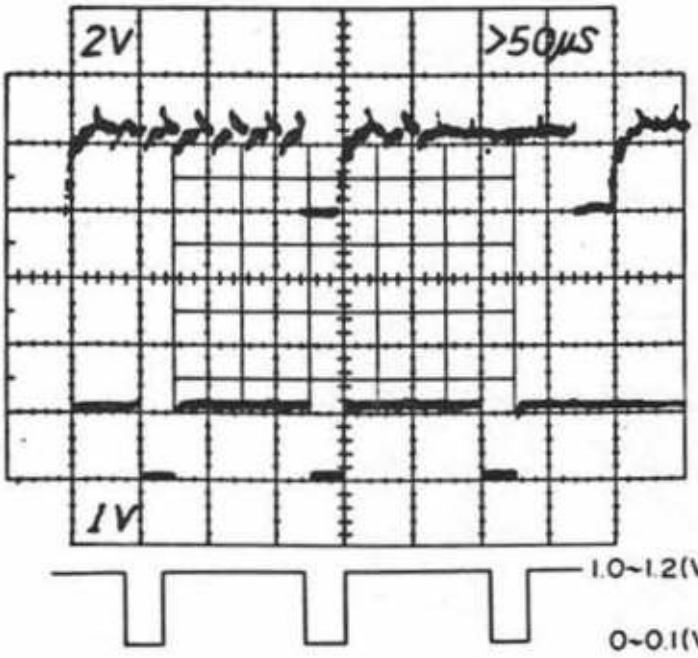


Fig. 3-3

(Use Bus Checker)

Waveform:

(Bus Checker Trigger)

Fig. 3-3 and Fig. 3-4 are I Bus samples. Word 1 (BV) is identical in eachsample but Word 2 shows AE mode in Fig. 3-3 and BCK (battery check) mode in Fig. 3-4.

	T.B(2)	T.B(3)	
	Model 1	Model 2	
Fig. 3-3	0	0	=AE Mode
Fig. 3-4	0	1	=BCK Mode

The I BUS World 1 output is in true binary code.

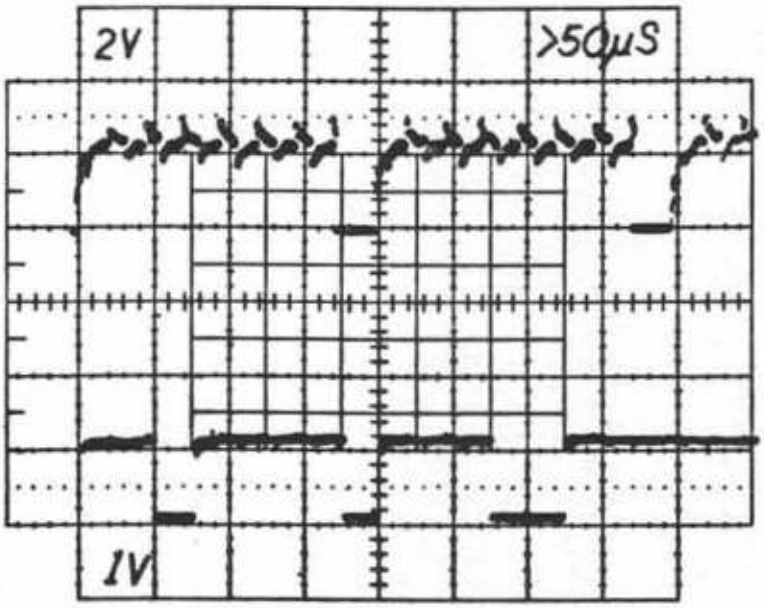


Fig. 3-4

Fig. 3-3 and 3-4 Word 1 is the binary coded brightness (BV) signal.

Binary code: 00100001 (MSD)*

Binary to Octal Conversion
Octal Code: 204

From EV, BVO Table
204 = AV0 1.2 EV 13

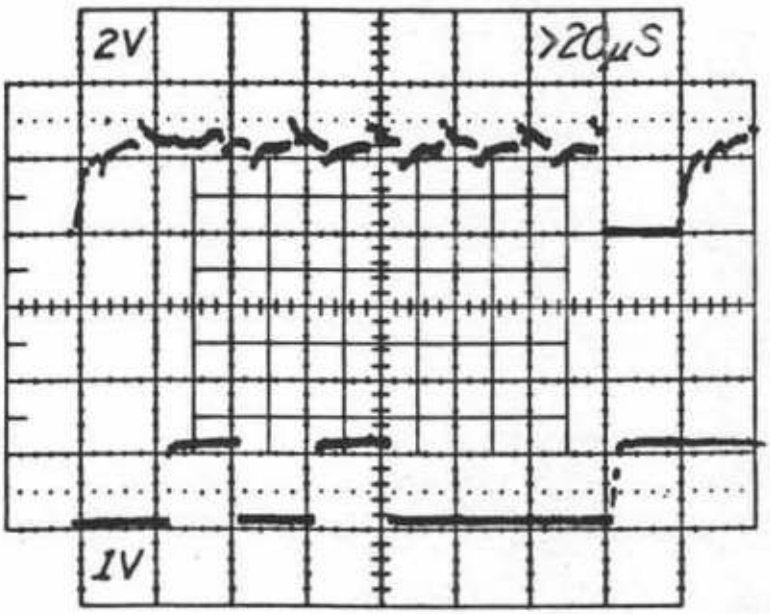


Fig. 3-5

Fig. 3-5 is the same I Bus output, but expanded to show only Word 1 (BV).

Binary code: 10101110 (MSD)*
or:

1 0 1 0 1 1 1 0

Binary to Octal Conversion

101 = 5

011 = 6

10- = 1

Octal code: 165

From EV, BVO Table
165 = AVO 2.5 EV12

---

*: As noted before, Bus Checker reads with the least significant digit at the left.

4. CLK (14P)

Clock Pulse Input from OSC/Interface IC. (See 3.3.15 CLK)

5. SYNC (D7) (15P)

System Trigger Input from Decoder Driver IC (3.3.14 D7)

6. VADJ (16P)

This pin has no external connection. Internally it is connected to the voltage divider on the low voltage interlock comparator.

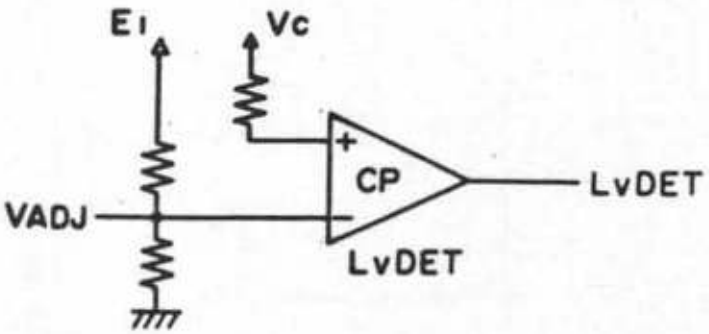


Fig. 3-6

7. BCK (17P)

Battery Checker Circuit and Clear circuit. During normal operation El is present at pin 17. When the battery check switch is closed, it is grounded.

Note: Circuit clear takes place when button is pressed, but since battery check actually energizes Mgl and Mg3 the outward signs of clear are not apparent until the button is released.

8. TP (18P)

Temperature compensation circuit Output (approx. 0.6V)

9. EV 18 (19P)

Normally the same voltage as EV 18 MOS OUT is present. -- Part of temperature compensation circuit. (Normally voltage is same as VC' = 1.219 ± 38 mV).

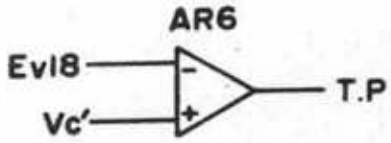


Fig. 3-7

10. GND (10P, 20P)

IC ground connection

11. AD NULL L (2P), AD NUL 2 (1P)

Offset adjustment for operational amp for the A/D convertor. Adjustment is similar to AE-1's PX-1 offset adjustment.

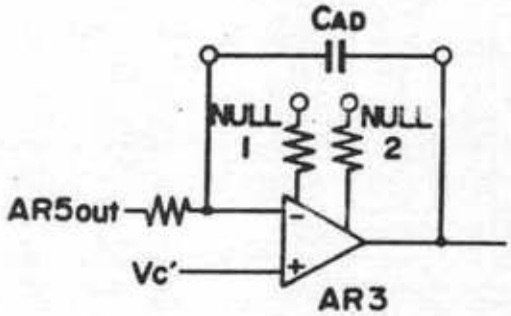


Fig. 3-8

12. CAD (3P)

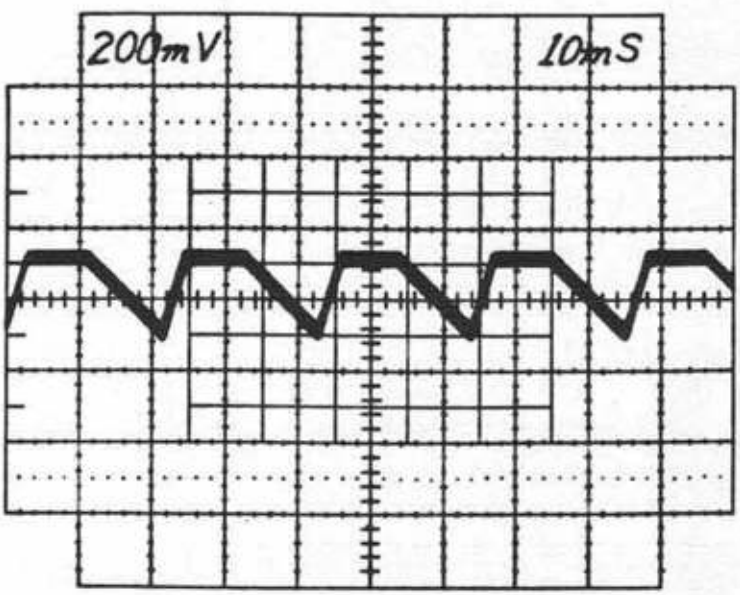
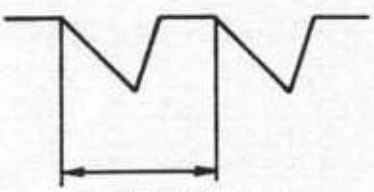


Fig. 3-9

Brightness Analog to digital convertor amplifier output to A/D capacitor (CAD).



After metering is started, a delay of 3 AD time units takes place before digitally converted BV information is sent from the Input IC thru the I BUS to the CPU IC. This is to provide stabilization time for the SPC. (See also 17 AR5 OUT)

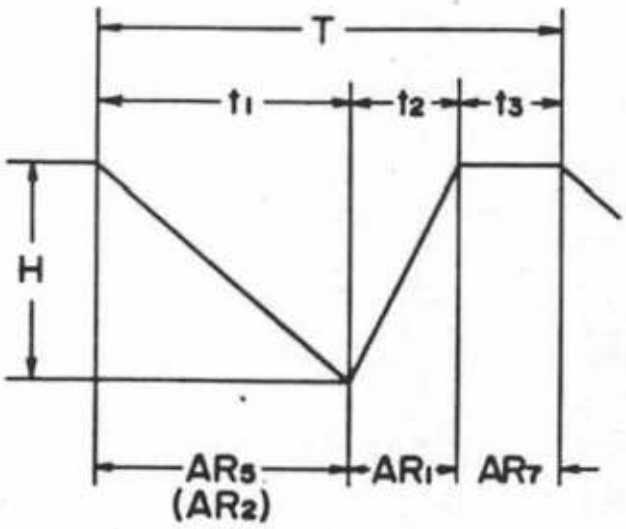


Fig. 3-10

- o Fig. 3-10. is a schematic representation of the dual ramp intergration analog digital convertor.
- o H changes inversely with brightness.

  High BV = Small H

  Low BV = Large H
- o t_1 is fixed at 10 mS
- o t_2 varies with BV ie H

  High BV = Small H = Short t_2

  Low BV = Large H = Long t_2
- o T is fixed

(See also Fig. 3-15, Fig. 3-16)

13. CAD + (4P)

    BV A/D convertor capacitor CAD input to amplifier.

14. El (5P)

    Main supply voltage for all circuits. (Approx. Battery voltage - 0.3V).

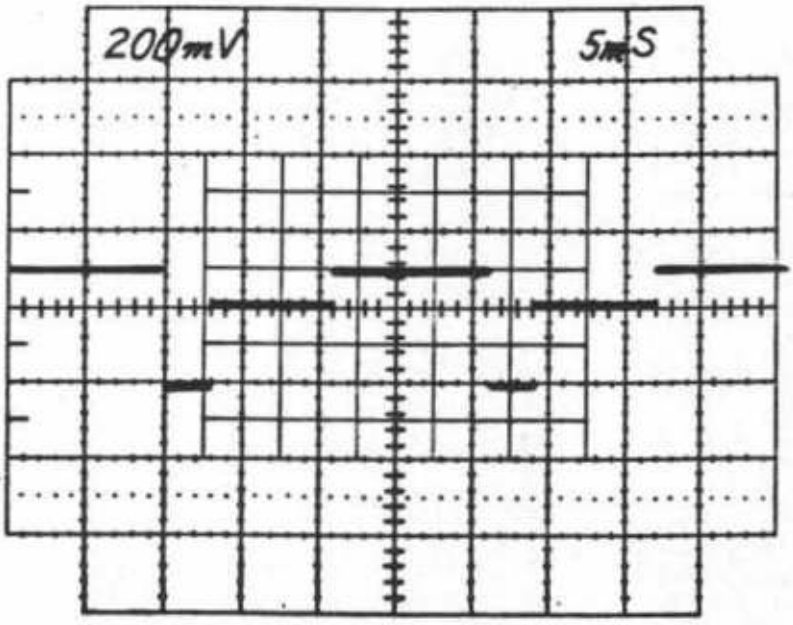
15. KVC

    Standard control voltage for most circuits.

16. AR5I (7P)

    KVC = 1.625 ± 5% (See also Fig. 3-17)

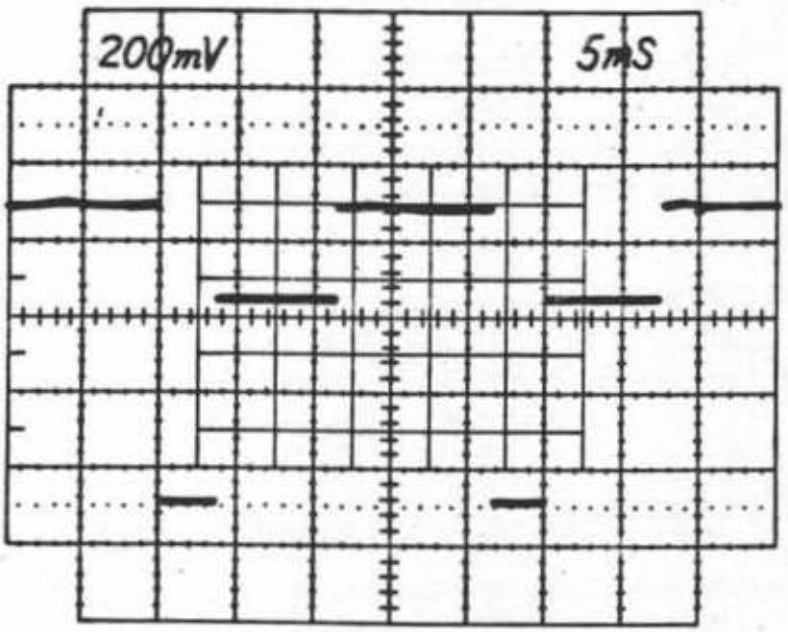
    Note: KVC, rather than Vc used in the AE-1 is the standard voltage for the A-1.



Input to AR5 operational amplifier which is MOS OUT from OPT IC.
(See also 17)

Fig. 3-11

17. AR5O (8P)



Out of AR5 operational amplifier which is amplified MOS OUT.

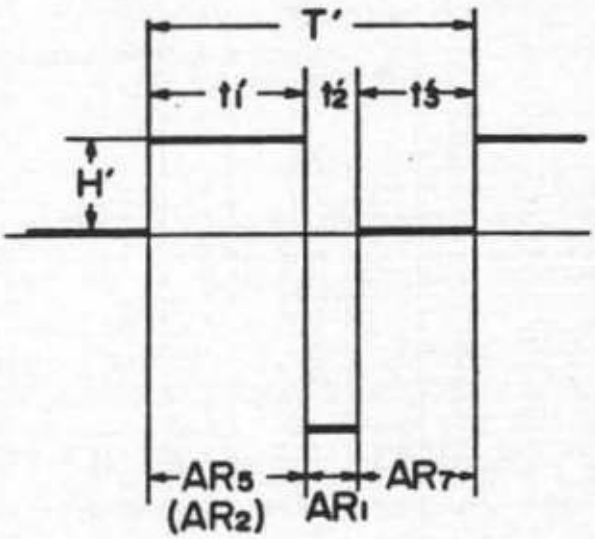


Fig. 3-12

Fig. 3-13

- o H' varies with brightness:
  - High BV, H' is small
  - Low BV, H' is large
- o t_1' is fixed at 10 mS

- t_2' varies with brightness:
  High BV, t_2' is short
  Low BV, t_2' is long

- Fig. 3-14 shows the schematic for the circuit is used in the A/D conversion whose waveforms are shown in Fig. 3-10 and 3-13. The following is true:
  $T = T'$, $t_1 = t_1'$ and $t_2 = t_2'$

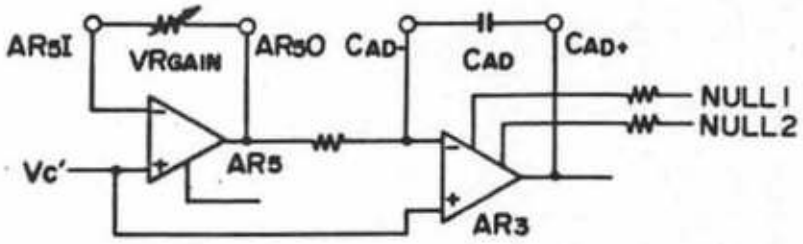


Fig. 3-14

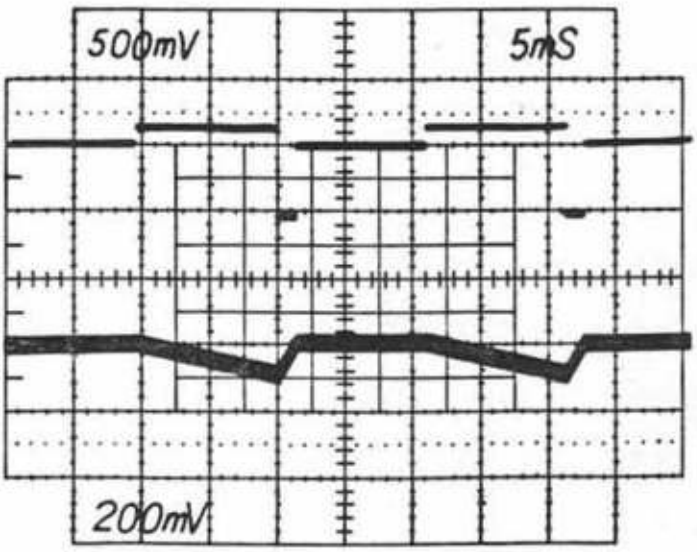


Fig. 3-15

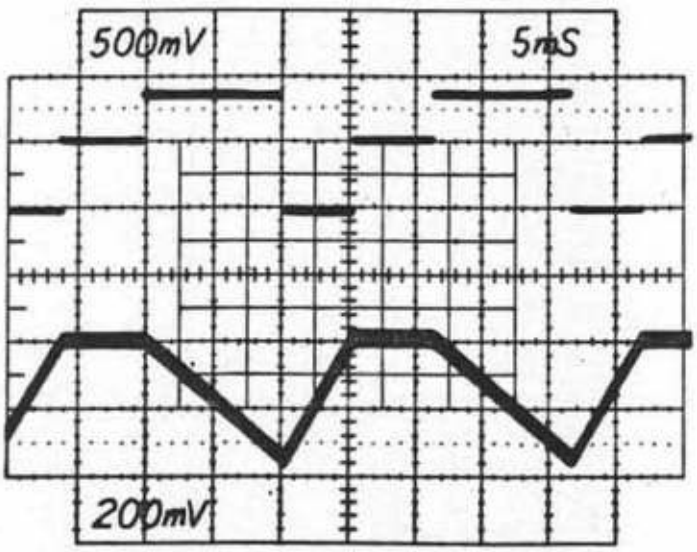
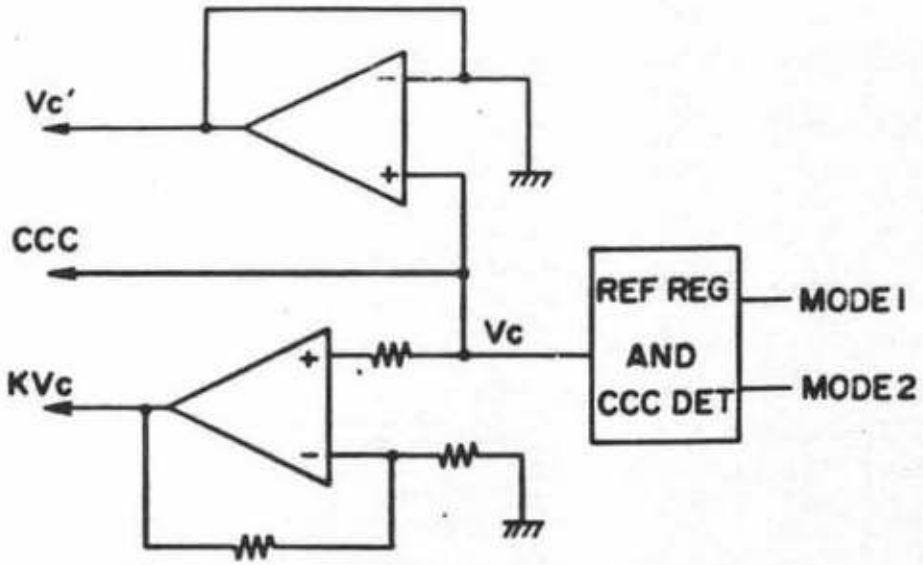


Fig. 3-16

Fig. 3-15 and 3-16 show the AR5 output and CAD- waveforms superinposed for easy understanding. Fig. 3-15 = High BV, Fig. 3-16 = Low BV



Standard voltage (same as VC = 1.219 ± 38 mV)

Fig. 3-17

3.3 CPU IC (SN28720)

1. E_1LK (1P)

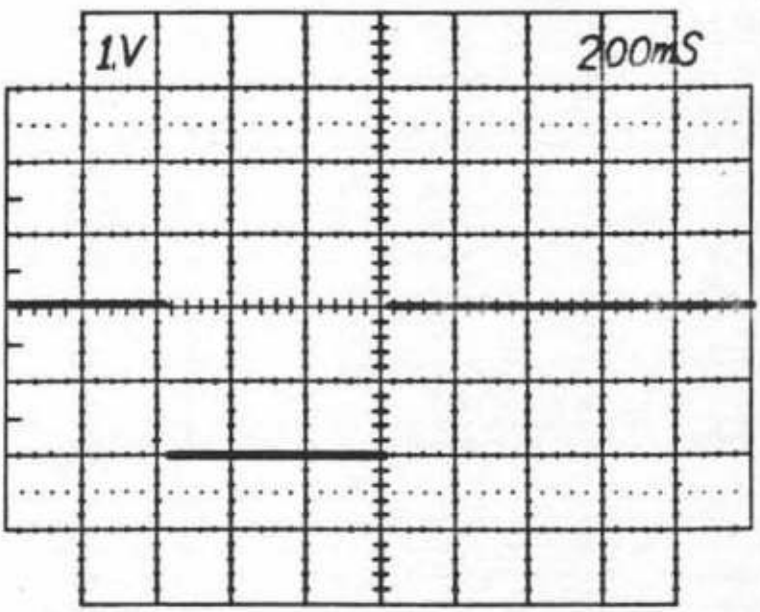
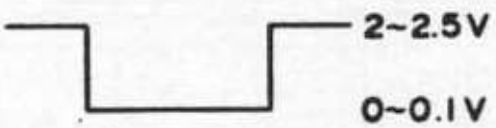


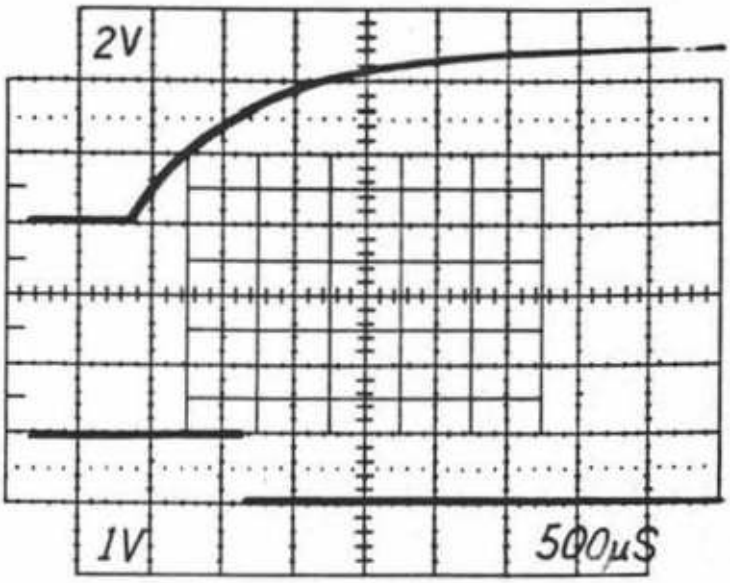
Fig. 3-18

El LK is the power supply (EL) latch-in circuit. It locks the El supply on for long enough to cover the shutter operation time plus the cycle time before and after the actual shutter operation.
(This provides a power supply even if the shutter button is not pressed throughout the operation.)

Ex: For 1/2 sec. shutter, the El LK gate is approx. 600 mS long.



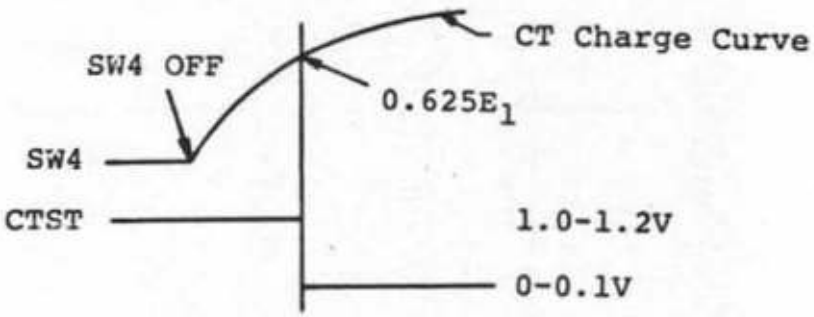
2. CTST (2P)



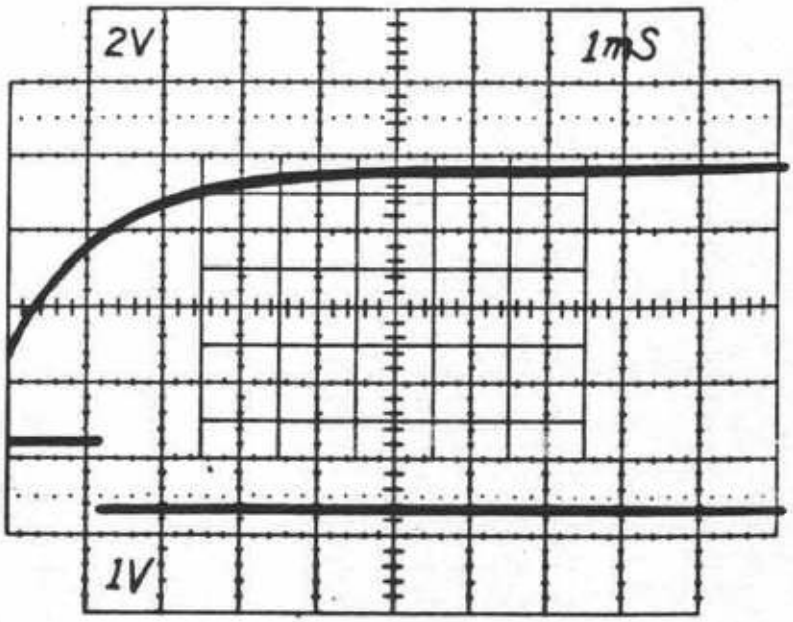
(Use SMG1 trailing edge (positive-going) trigger and syncroscope delay)

CTST is short for count start. S4, the count switch, is turned off when the 1st curtain starts. This allows CT to charge. When it reaches 0.625E1, the count start comparator changes states and shutter timming starts.

Fig. 3-19



The count start (CTST) timing is adjusted by VRT. This adjust the slope of the CT charge curve so the start of the shutter timing to coincide with the time when the leading edge of the slit just enters the aperture. (See also Fig. 3-56, Fig. 3-57)

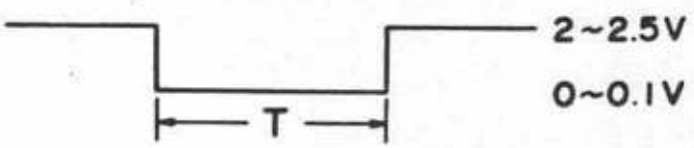


If the oscilloscope in use has no sweep delay, SW4 opening can be used to trigger the scope, but display of the start of CT charge is not possible. (Fig. 3-20)

Fig. 3-20

3. SMG1 (3P)

This is the output gate to OSC/Interface IC for MG1 operation. (See notes 2 and 3 on the Exposure Timing Chart)



Gate length (T) varies with the aperture being set. Smaller apertures require a longer gate.

Fig. 3-21

4. Bias (4P)

This is a bias voltage originating in the OSC/Interface

IC which is used in the CPU IC to raise the base reference voltage waveforms to an approiate level for operation. The bias voltage is normally 3.5 to 4 volts.

5. SMG3 (5P)

This is the output gate to the OSC/Interface for MG 3 operation. (See also Fig. 3-41)

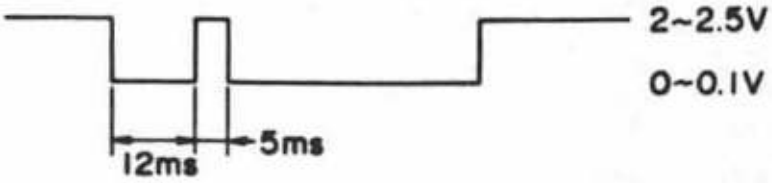


Fig. 3-22

MG2 requires only a short signal for operation. There is no separate "SMG2". The combination of SMG1 low and a 5 mS SMG3 high after 12 mS of SMG3 low provides the acitvation signal for MG2. (See also Fig. 3-43)

6. SV (6P)

(Trigger: D7)

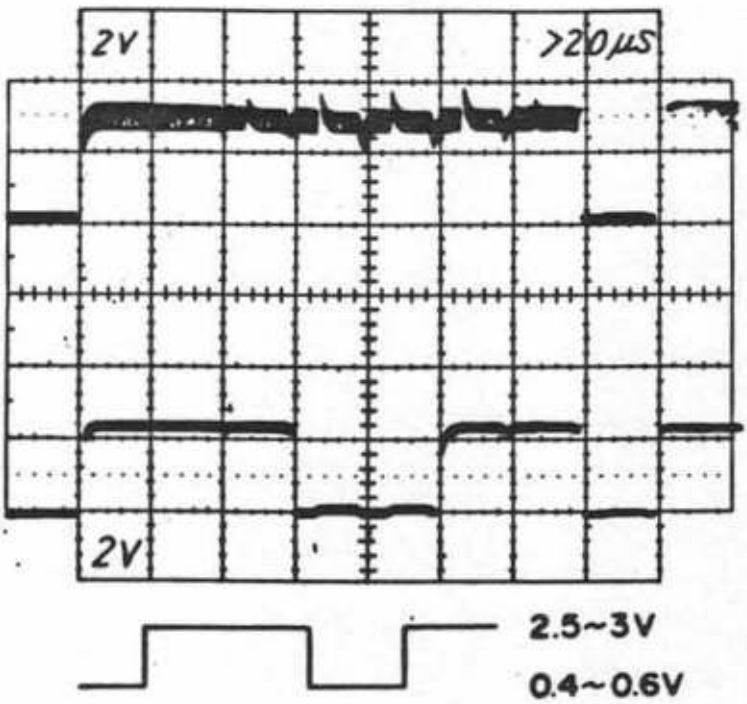


Fig. 3-23

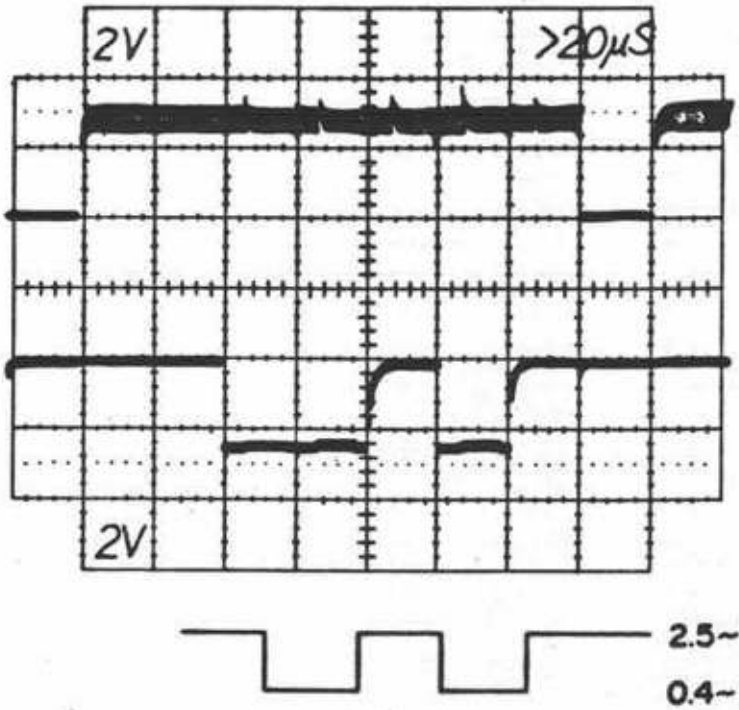
This is the film speed (ASA) gray code input to the CPU.

Fig. 3-23 Gray code: LSD 000011001

SV code is from TB2 thru TB7.

SV: 011001 = ASA 100

7. A/T (7P)



(Trigger: D7)

Pre-programmed AV or TV. Depending on the priority mode selected, this signal is either the shutter speed (shutter speed priority) or Aperture (aperture priority) set on the A/T dial. It is in Gray code.

Gray Code:

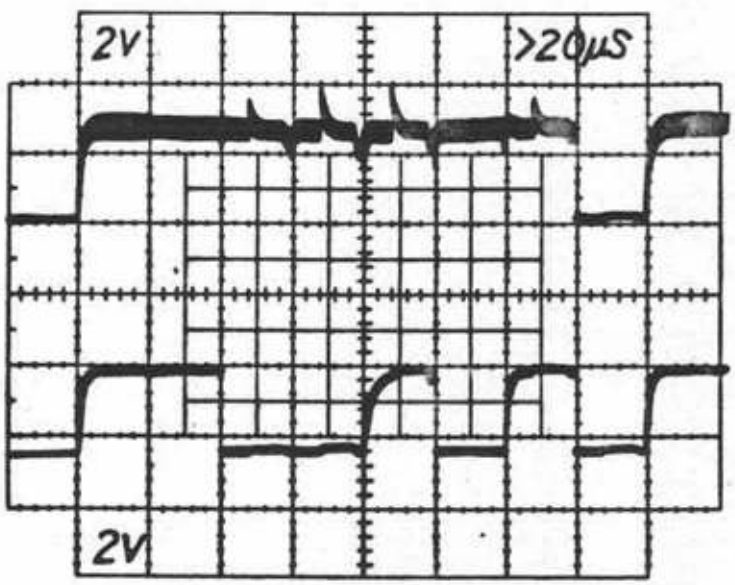
LSD 00110100

T.B 7 is 0 = Shutter Speed Priority Mode (SSLC)

T.B 2 thru T.B 6 indicate shutter speed selected.

11010 = 1/1000 sec.

Fig. 3-24



In Fig. 2-35 Gray Code, T.B 7 is "1" indication that the camera is set to the AV (Aperture priority) mode.

T.B 2 thru T.B 6 Gray Code:

11010. From the AV Code Table, this is f/19.

Fig. 3-25

8. CNTL (8P)

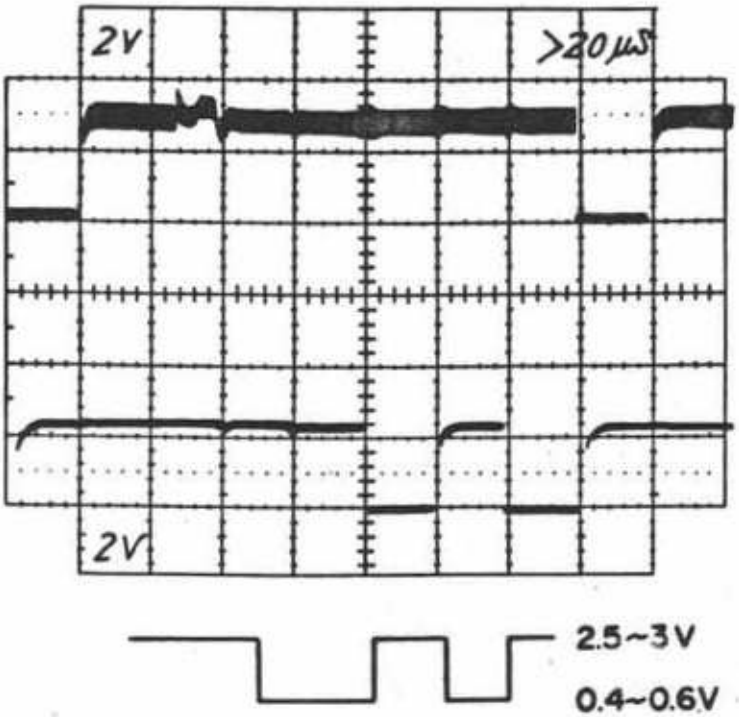


Fig. 3-26

(Trigger: D7)

Self timer Time 1, Time 2, Lens Manual setting and Stopped-down diaphragm singles enter the CPU thru this pin.

Fig. 3-26 Gray Code:

LSD 00001010

CNTL code uses T.B 3 thru T.B 6 so: 0101

From the CNTL Table, we decode this as full aperture metering, manual and the self timer set to 2 seconds.

The T.B 7 code "0" also indicates shutter speed priority.

9. AVO (9P)

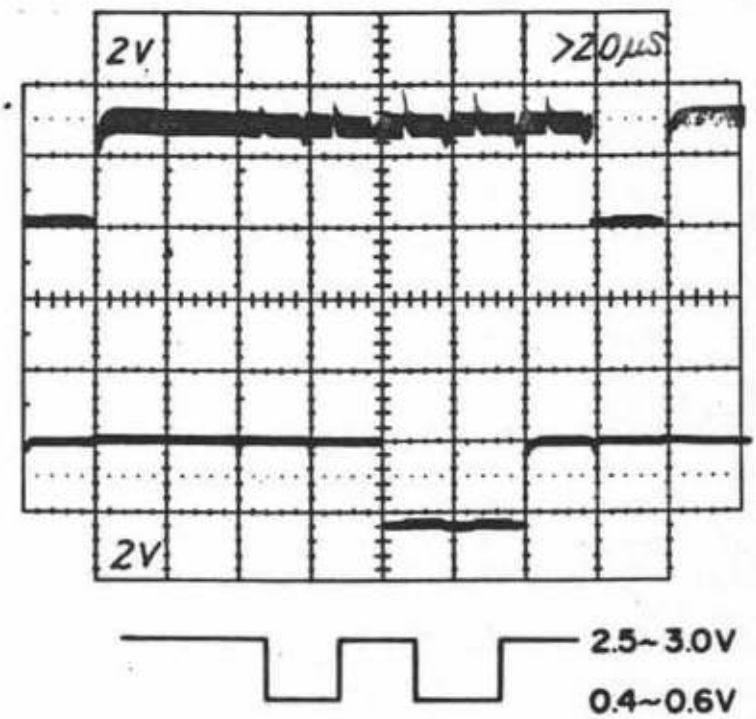


Fig. 3-27

(Trigger: D7)

This is the code for the maximum aperture of the lens mounted on the camera. (If no lens is mounted, the code is the code for f/5.6.). This code actually serves the dual purpose of AVO, maximum aperture information input, and AVC, maximum aperture correction. (The AVC signal actually originates within the IC.)

Fig. 3-27 Gray Code: 00001100

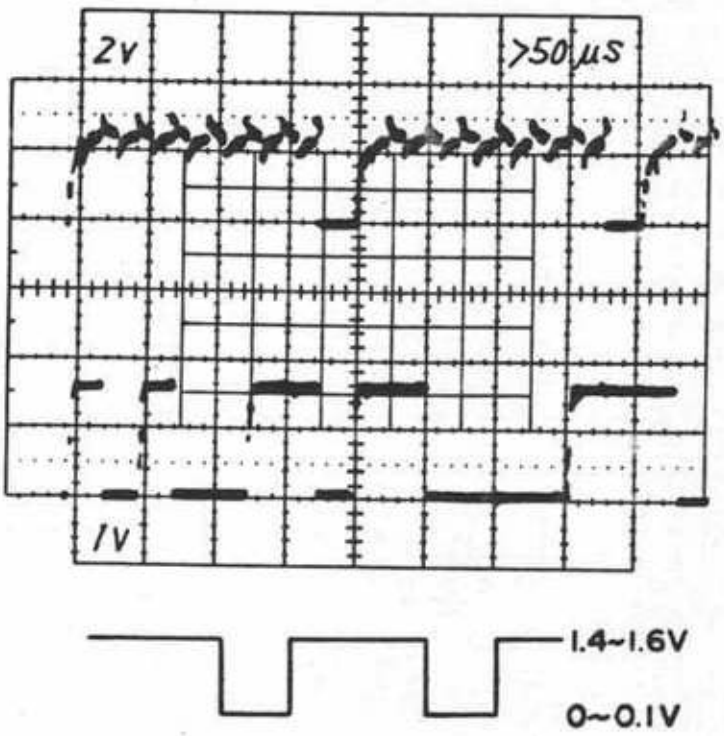
AVO uses T.B 3 thru T.B 6 0110 which is f/1.4 as shown in the AVO, AVC table.

10. O BUS (10P)

Once every 500 mS the CPU send three words of information to the Decoder Driver IC thru the O BUS, or output busline. Only the TV and AV words can be checked with the Bus Checker. The Bus Checker trigger is used.

T·B. 0	T·B. 1	T·B. 2	T·B. 3	T·B. 4	T·B. 5	T·B. 6	T·B. 7
DISP(M)	DISP(2)	DISP(3)	DISP(4)	DISP(5)	DISP(6)	DISP(7)	DUMP
		TV(½)	TV(1)	TV(2)	TV(4)	TV(8)	TV(16)
F	EEE	AV(½)	AV(1)	AV(2)	AV(4)	AV(8)	BULB

Fig. 3-28



(Tool and Trigger: Bus Checker)

(Camera: TV, 1/1000)

The visable 0 Bus output is binary code of the TV and AV signals. (Fig. 3-28)

Figure 3-29 shows the oscilloscope waveform of the TV signal (first word) and AV signal (second word).

Fig. 3-29 Word 1 Binary Code: 01011001

TV Signal Code (T.B 2 - 7) 011001 converts to Octal Code:

From the TV Code Table:

230 = 1/1000 sec. shutter speed

Fig. 3-29

The second word in the code displayed in Fig. 3-29 is the AV code. As shown in Fig. 3-28, T.B 0 and T.B 1 are not a part of the AV code. When converting to Octal code they should be considered as "00" (This is true of the TV code also).

Word 2 Binary: 00111100 = Octal Code 074 (from the AV Code Table)

Octal 074 = f/9.5

Note: The 0 BUS information is rounded off to the nearest 1/2 step because it is the input information to the display decoder driver IC. The actual working outputs to the OSC/Interface IC are stepless in principle (actually 1/8 EV steps)*.

*: The control should be refered to as stepless in information released to the public.

As stated before, T.B 0 and T.B 1 are disregarded when converting from binary to octal code. In the AV word they actually serve a different function.

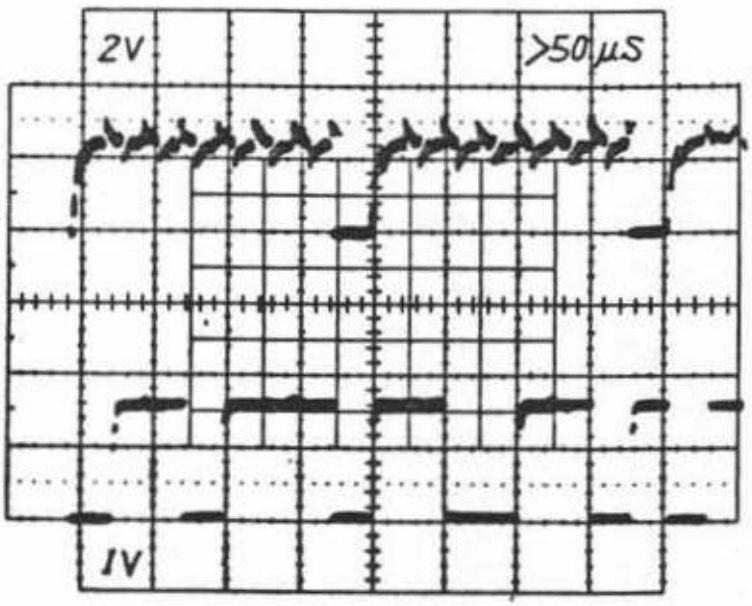


Fig. 3-30

(Camera: AV Priority Mode)

(Tool & Trigger: Bus Checker)

When the camera is in AV priority mode, T.B 0 and T.B 1 do carry shutter speed information although it is modified for rounding off the display information to the nearest 1/2 step shutter speed.

For example, in figure 3-30 word 2 is 00110010 which converts to octal code 114 or f/19.

Word 1 indicates the shutter speed calculated by the camera. Using the entire binary 10010001 converts to octal 211 which is the modified code to round off the display. To find the actual shutter speed, subtract octal 002 from the octal code. In this case the true shutter speed is octal 207 which is 1/8 step slower than octal code 210 which is 1/250 second.

Note: The above method of calculation can be used, but the method used in explaining Fig. 3-29 where T.B 0 and T.B 1 are considered as "00" is simpler and less prone to error.

11. GND (11P)

Ground (Earth) Connection

12. SAVE (12P)

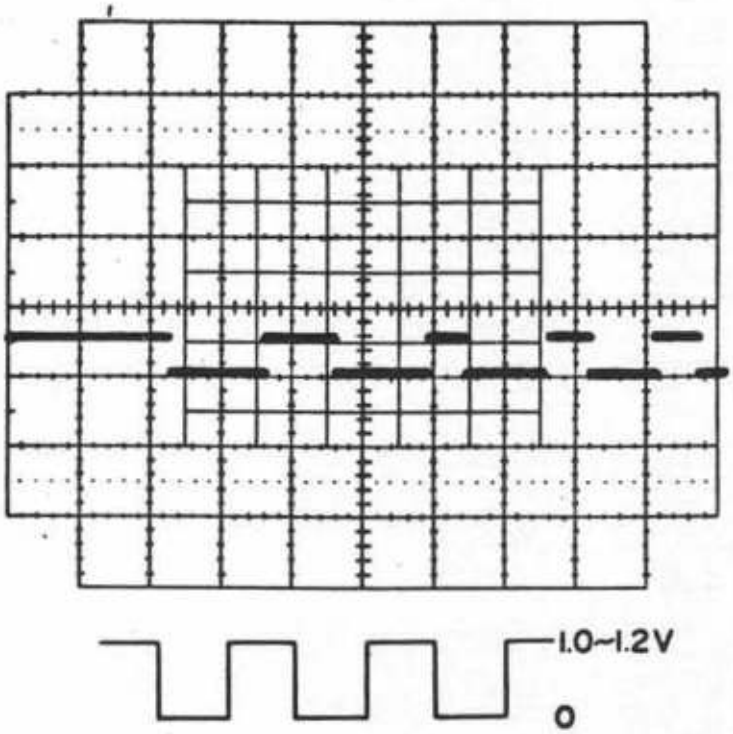


Fig. 3-31

(Trigger: AECG)

This is the signal from the segmented aperture value electrode plate (SAVE) to the CPU IC. It consist of an ON-OFF series as the brush passes over the plate.

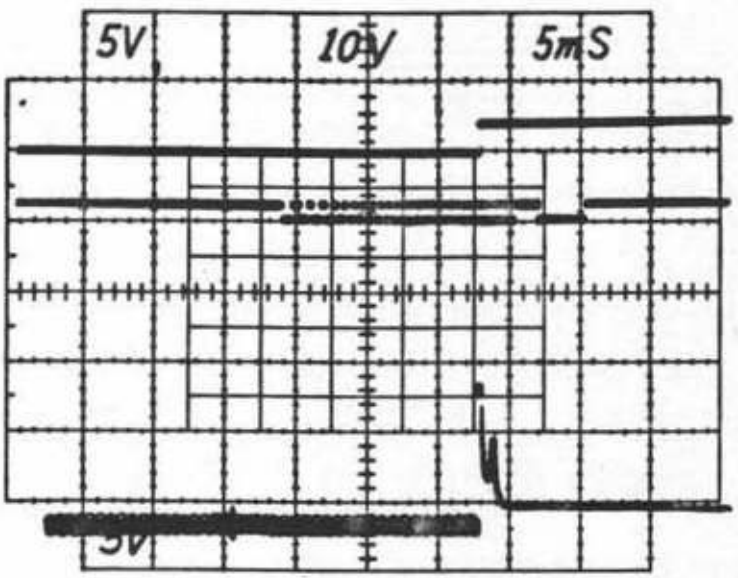


Fig. 3-32

(Trigger: SMG1 leading edge, negative going)

(Note: This waveform is included for information only. It is not normally possible to simultaneously display three waveforms.)

This waveform shows the relationship between the SAVE signal, SMG1 signal and the release of MG1.

13. AECG (13P)

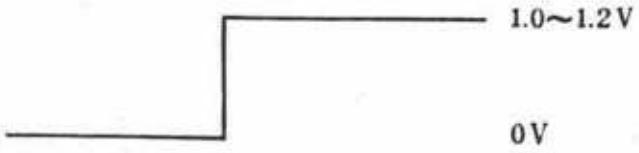


Fig. 3-33

AE Charge Signal

This signal is the input which tells the CPU that the AE mechanism is charged.

When charged, this point is grounded giving a low. Since the unit works on "active low", this is a "1". If not charged approx. 1V is present.

14. SYNC (D7) (14P)

(Trigger: D7 leading edge, negative going)

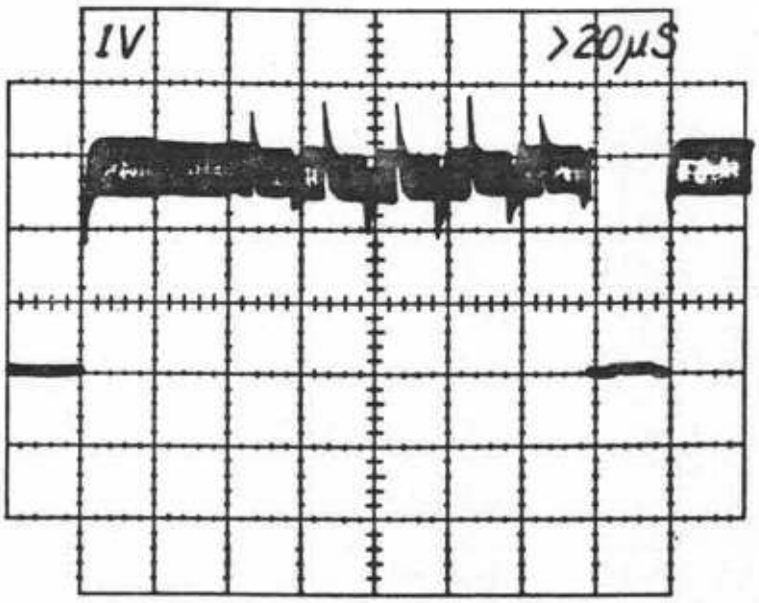


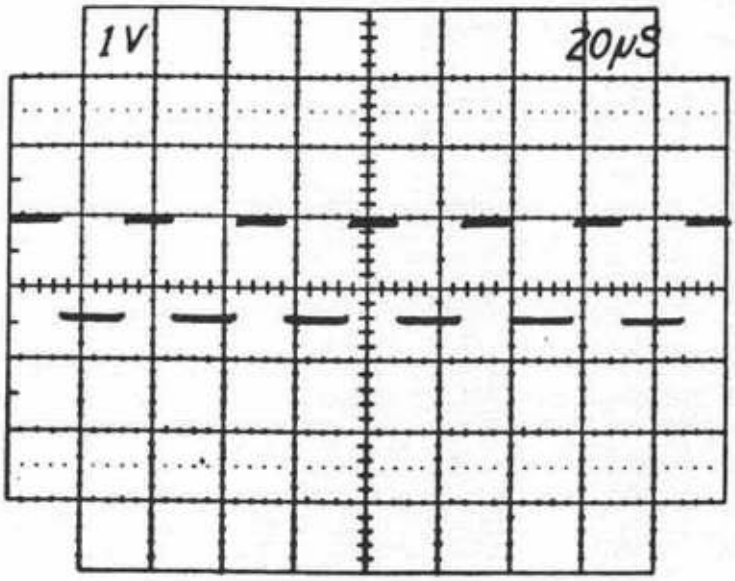
Fig. 3-34

SYNC (D7) is the system trigger. It is used as the trigger for the bus checker and most oscilloscope checks. It is available on a test pad on the ridge over the pentaprism.

Figure 3-34 is the D7 waveform. There are 8 bits in one cycle of the D7 waveform, numbered from the left T.B 0 thru T.B 7. The last bit (D7) is a low and the others are all highs. Since this unit uses eight bit words, T.B 0 thru T.B 7 define one word. When looking at "wordforms", it is convenient to take the oscilloscope time base off the calibrated position and adjust the sweep length so one bit is one scale division long on the display. (When this is done on the example waveforms they are marked >20μS in the upper right corner.)

This D7 leading edge trigger was used in the example above, but the trailing edge (positive going) trigger is useful for many test.

15. CLK (15P)



This is the basic timing pulse, or clock pulse, for the entire unit. It originates in the OSC/ Interface IC.
Its frequency is 32,768 Hz.

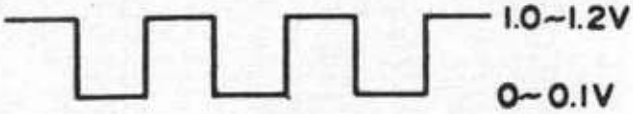


Fig. 3-35

16. I Bus (16P)

This is the input for the I Bus information. (See also 3.2.3)

17. KVC (17P)

This is the standard reference voltage input (KVC = 1.625 ± 5%)

18. DISP (18P)

Input signal from viewfinder display switch (SW3). When the switch is on, the display is off, and pin 18 is at ground. When the switch is off, the display is on and the voltage at pin 18 is approximately 1 to 1.2V.

Fig. 3-36

19. STK2 (19P)

Fig. 3-37

STK2 stands for stroke two, or the closing of the second shutter button switch SW2. When SW2 is closed, the voltage at pin 19 is 0.4 ~ 0.6V. When the switch is off, the voltage is 2.4 to 2.6 volts.

20. END (20P)

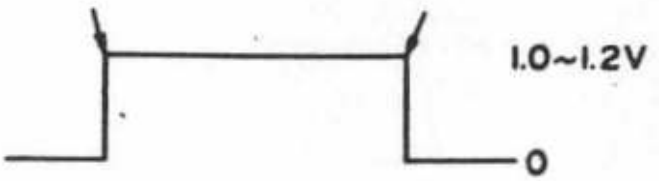


Fig. 3-38

This is the SW5 winding completion signal input. When winding is complete, this pin is at ground. This signal releases the E1 latch (E1LK).

21. AE LK

Fig. 3-39

This signal retains the BV signal present at the time the AE LK is actuated. The exposure value will remain the same even if the A/T dial is changed. The calculated value will change to maintain the same EV for the value which has been set.

22. SLED (22P)

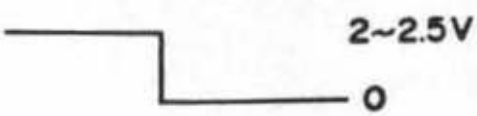


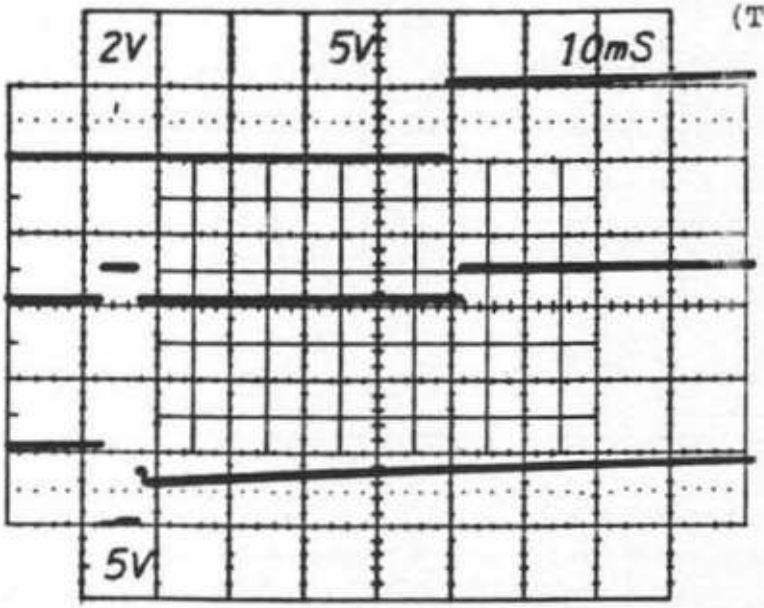
Fig. 3-40

LED drive signal.

3.4 OSC/INTERFACE IC. (SN28722)

This IC provides the clock pulse and system trigger for the entire system. It also provides the interface between the computer and the operational elements (magnets).

1. MG2 (1P)



(Trigger: SNG1 negative going)

MG2 is activated by the combination signals, SMG1 and SMG3. Both SMG1 and SMG3 go low together. 12 mS later SMG3 goes high for 5 mS. This release MG2. (It also electrically releases SMG3 but it is still latched mechanically.

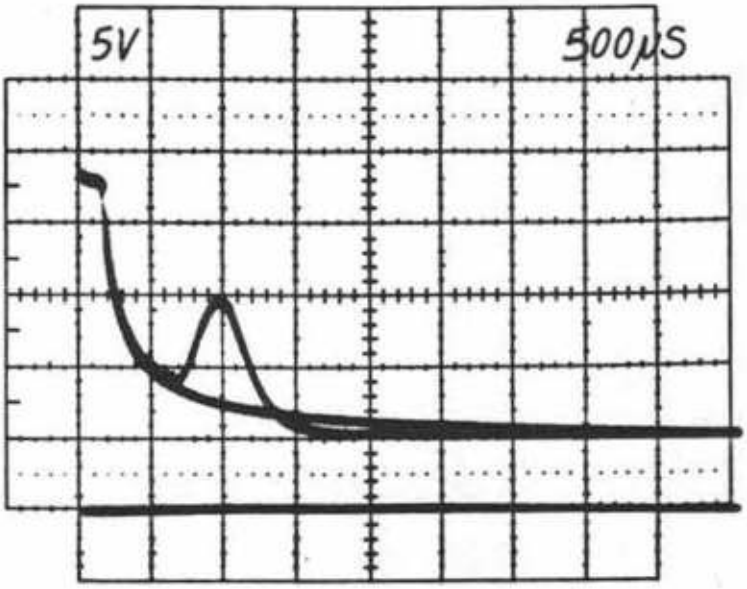
Fig. 3-41

When viewing the MG2 waveform, the C47 charging curve is noticable.

2. MG3 (2P)

This is the operation signal for the 2nd curtain magnet (MG3). As mentioned above, MG3 is turned off once but it does not release because it is held mechanically.

Fig. 3-42 shows the release curves for the first (false) release and the actual release superimposed since they have the same timing from the trigger. (See also section 3.14.18)



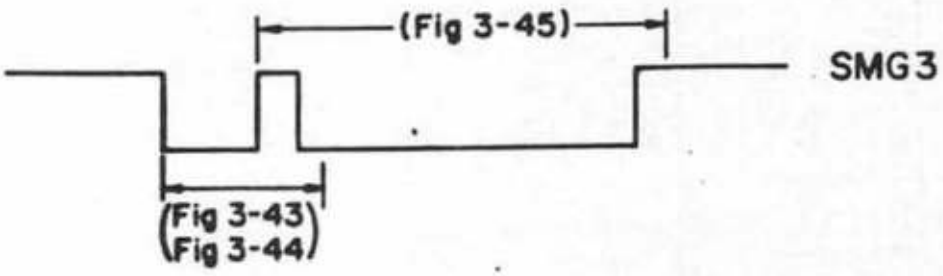
(Trigger: MG3)

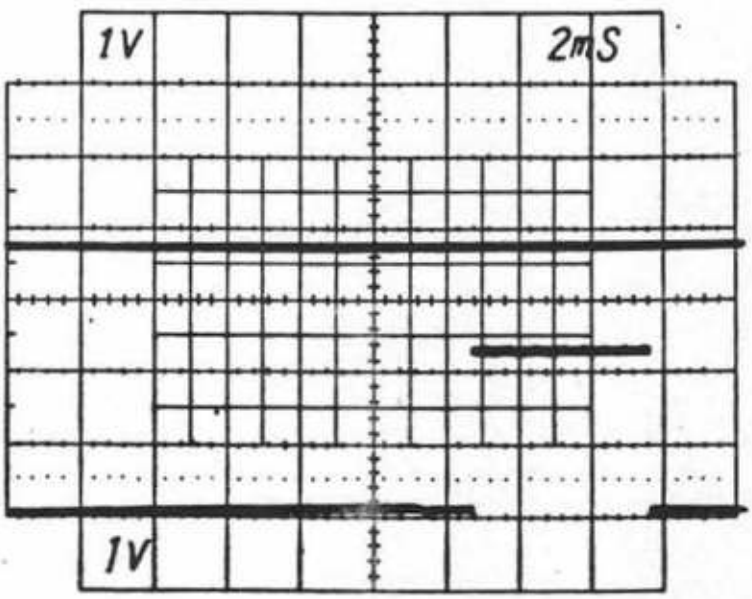
(The form with the reverse current spike is the actual release. This spike occures when the yoke and armature actually release.)

Fig. 3-42

3. SMG3 (3P)

SMG3 is the MG3 operation signal from the CPU IC. The following three waveforms (Fig. 3-43, 44, 45) illustrate the signal.

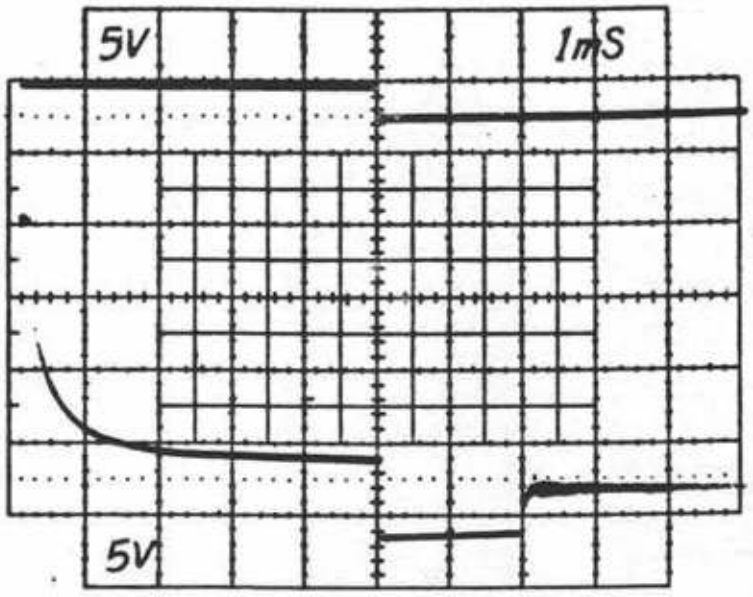




(Trigger: SMG1 negative going)

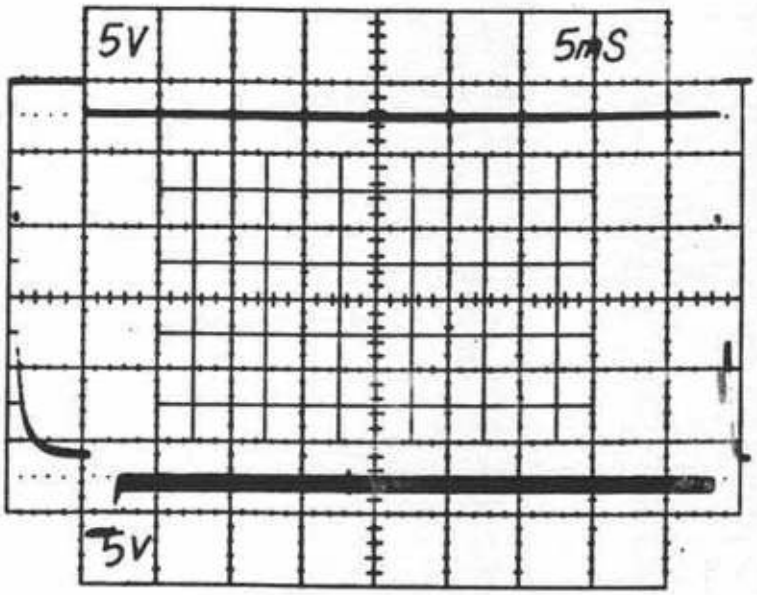
This shows the 5 mS gate used to release MG2. It occures 12 mS after SMG1 and SMG3 go low together.

Fig. 3-43



During the 5 mS that the MG3 holding current is off, it is held mechanically, so it shows a smooth curve without the reverse current spike.

Fig. 3-44



This waveform shows both the "false release" and true release. The reverse current spike can be seen in the true release at the right edge.

Fig. 3-45

4. Bias (4P)

   Bias voltage output for the CPU operation.
   Bias: 3.5 - 4.0V

5. SMG1 (5P)

   MM1 operational signal gate. (See also 3.3.3.)

6. CTST (6P)

   Count Start signal for shutter timing. (See also 3.3.2)

7. ElLK (7P)

   El lock-in signal from CPU IC. (See also 3.3.1)

8. SLED (8P)

   LED operation signal input. (See also 3.3.22)

9. OSC (9P)

   Clock pulse frequency adjustment resistor attaches to this pin. Frequency is adjusted by changing the resistor.

10. GND (10, 20P)

    Commonly called ground or body earth, this is the electrical "common" for the unit.

11. I SET (11P)

    This the tiepoint for the resistor which determines the current flow through the magnet coils.

    Coil current: 8 mA (With SW1 on = approx. 0.3 V)

12. VCO (12P)

    Input to voltage controlled oscillator for the battery checker. Frequency is adjusted by changing capacitor CVCO. (With SW1 on V = about 1 volt; when the Battery Check is pushed the voltage is about 1.5 V) pulse height. (With 6 V input, frequency should be 6 ± 2 Hz. At 3.5 V, frequency should be 2 ± 1 Hz)

13. PNP (13P)

    When ElLk signal is applied to pin 7, this pin becomes ground. It provide a ground for the El transistor TR even if SW1 is not closed.

14. KVC (14P)

    IC standard reference voltage input.

    $$KVC = 1.625 \pm 5\%$$

15. CLK (15P)

    Output form clock pulse generator (See also 3.3.15)

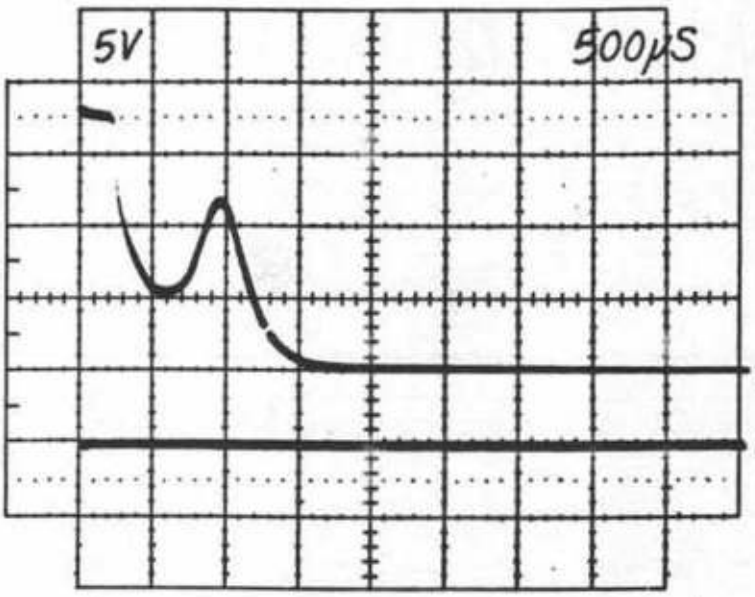
16. E1 (16P)

Main power supply voltage input.
(E1 = Approx. $V_{batt.}$ -0.3V)

17. LED (17P)

Self timer and battery checker LED operation signal.

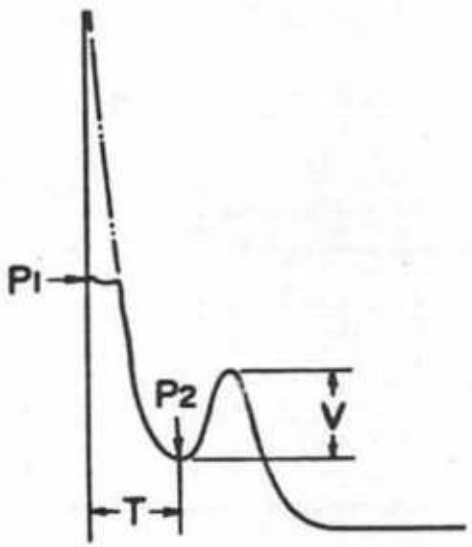
18. MG1 (18P)



Mg1 is the AE magnet operation signal gate.

The condition of Mg1 can be determined quite accurately by studing the waveform on the Mg 1 release. Scratched or fould armatures can be recognized. Uneven release of the AE mechanism and shutter can be seen.

Fig. 3-46



When the currnet is terminated, a very high voltage spike occures. To control this a zener diode is incorporated into the IC which limits the spike to the P1 level shown in Fig. 3-47.

When the yoke and armature actually separate another spike occures. The timing and size of the spike are affected by condition of the magnet. Contamination, especially oil, can cause the yoke not to release properly and T becomes long. Misalignment of the armature and yoke produce a smaller than normal reverse current spike.

Fig. 3-47

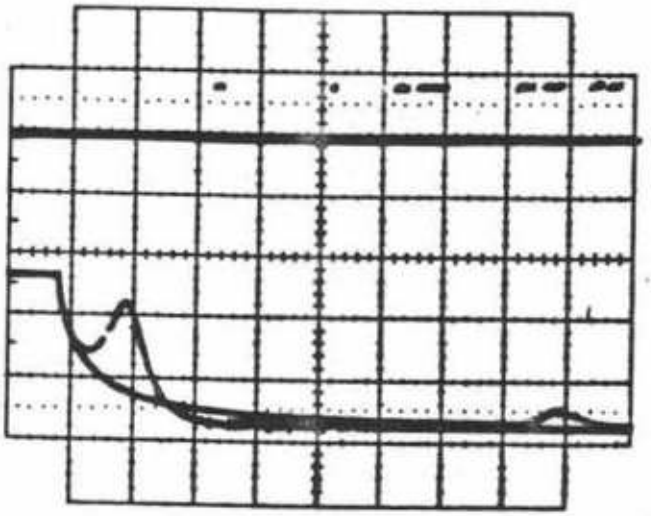


Fig. 3-48

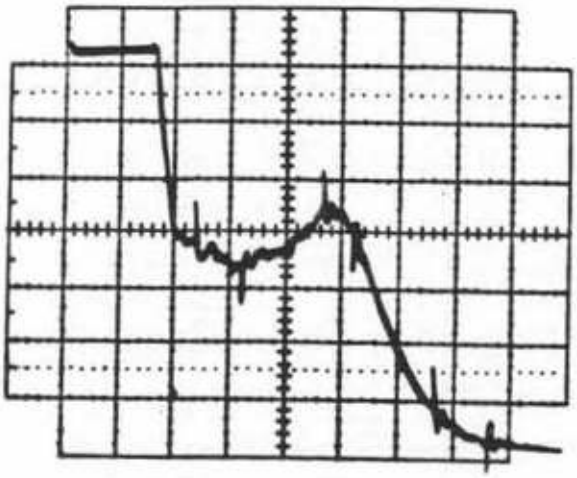


Fig. 3-49

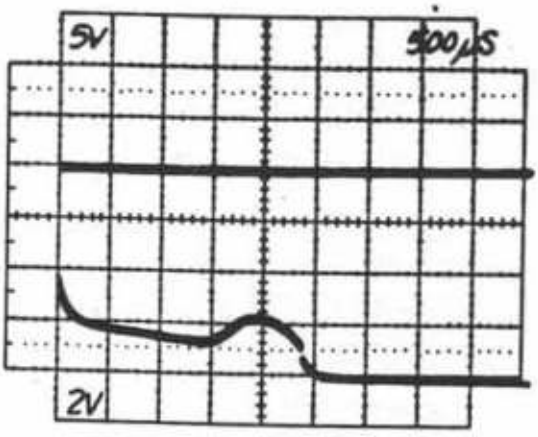


Fig. 3-50

Figures 3-48 thru 3-50 are examples of incorrect performance.

Figure 3-48 shows a normal condition (left) and an oily armature condition (right).

Figure 3-49 illustrates noise.

Figure 3-50 illustrates no regulation of first spike due to breakdown of the ZD.

Magnet Release Waveforms

	Release Time (T)	Spike Voltage (V)	Notes
MG1	<800 mS	>6 V	
MG3	<800 mS	>6 V	

19. TIME (19P)

Tie-point for SW4 and the CNST signal timing R-C circuit.

3.5 DECORDER DRIVER IC (SN28723)

This is the driver IC for the viewfinder display. It is mounted on a separate decoder driver flex which connects to the main flex by a special small connector. The main input to the decoder driver is the CPU'S 0 Bus. Since it is connected by a connector, the easiest method of troubleshooting is by replacement.

1. I ADJ (1P)

   Input to current adjustment circuit for segment drive.

2. Digits and Segments

   Each digit is made of seven segments. D2 thru D7 are normal alphametric 7 segment digits. D1 is a special digit. Six segments form the letter "M" for manual. The seventh segment is the decimal point between D6 and D7.

   1) Digits

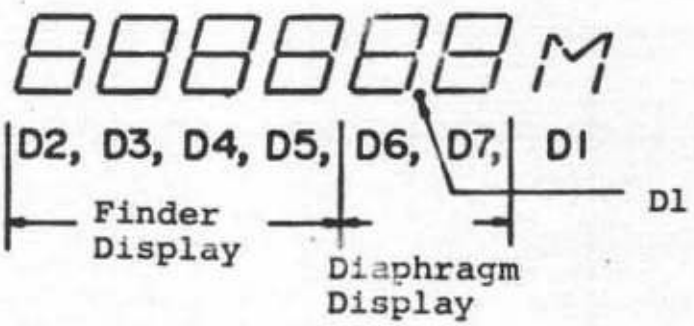


Fig. 3-52

   2) Segments

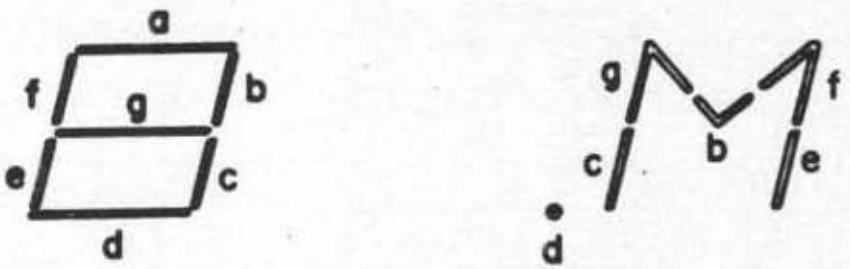


Fig. 3-53

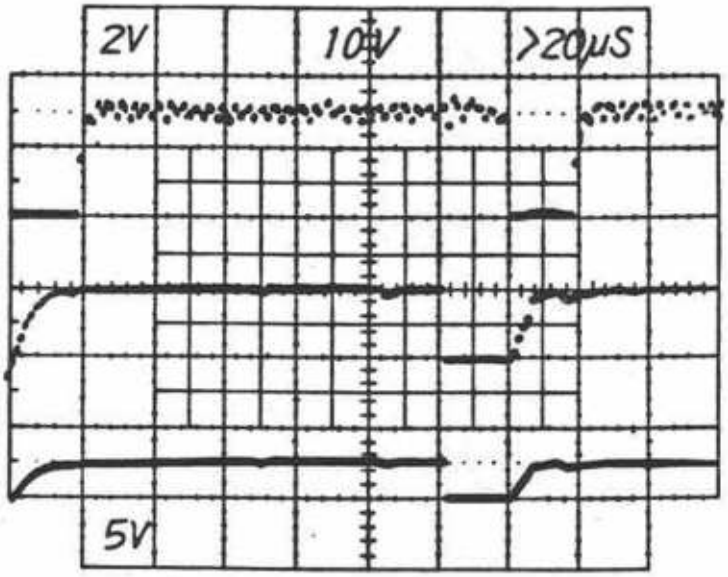


Fig. 3-54

Trigger: D7

Checkpoint: Digit D6

When checking the digit signal gate, there is sometimes little difference between the two states. To improve this, Place a 30-50KΩ resistor from V battery or E1 to the D6. The result will be better separation (Wave A).

In Fig. 3-54, D6 is low "1" so the gate is open for a lighting command from any of the segments.

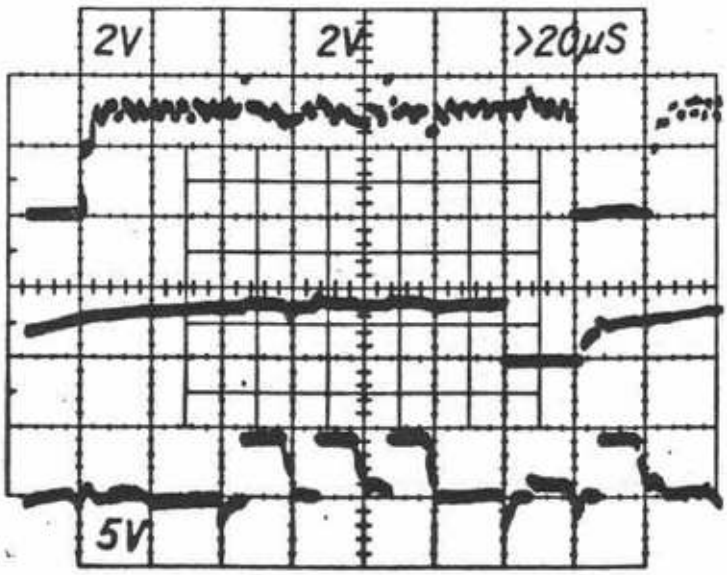


Fig. 3-55

Now that we know that the digit 6 gate is open, we can check Segments a thru g to see which segments of digit 6 are lit. From Fig. 3-55 we can see that segments a of digits D 2, 3, 4 and 7 are lit. Segment a of D6 is not lit. (Segments are "active high" i.e., a positive value indicates a lit segment.)

3.6 Sample Waveforms

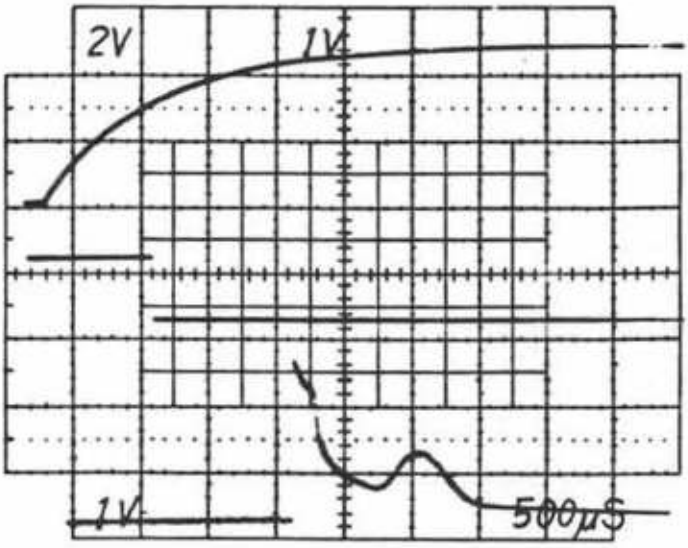


Fig. 3-56

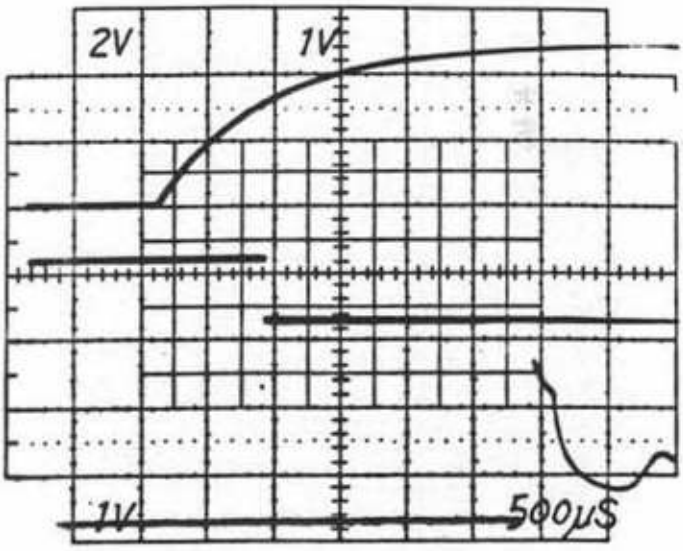


Fig. 3-57

SMG1 positive going trigger, Sweep delay

Top Trace: SW4
Middle Trace: CTST
Bottom Trace: MG3

Shutter Speed:
Fig. 3-56: 1/1000 sec.
Fig. 3-57: 1/500 sec.

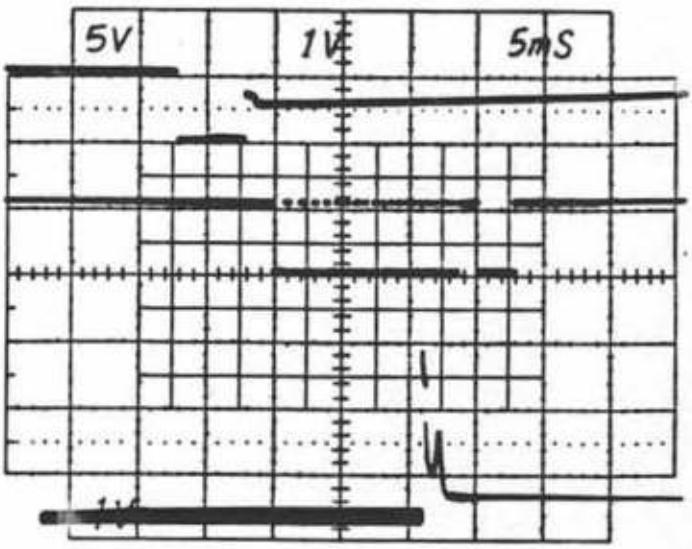


Fig. 3-58

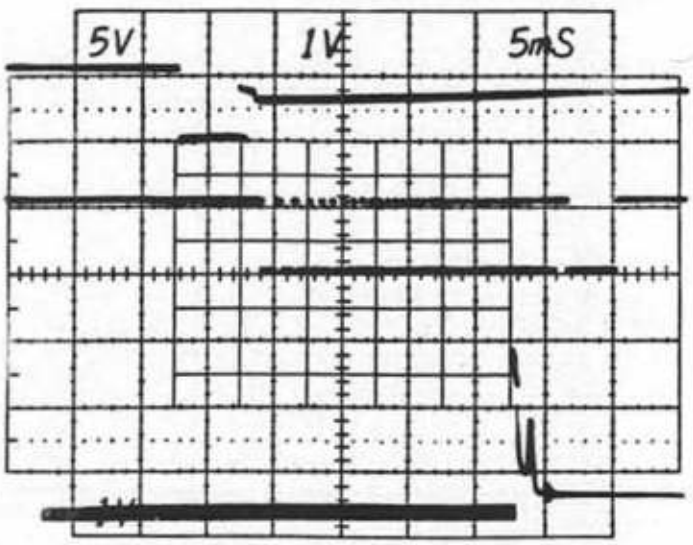


Fig. 3-59

SMG1 Trigger

Top Trace: MG2
Middle Trace: SAVE
Bottom Trace: MG1

Aperture

Fig. 3-58: f/2.8
Fig. 3-59: f/5.6

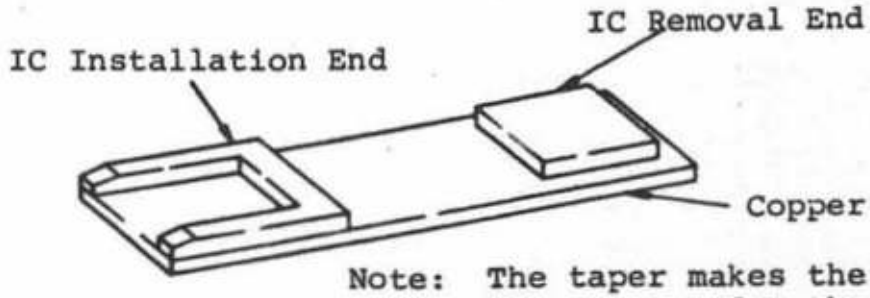
Note: These triple waveforms cannot be displayed simultaneously on most oscilloscopes.

4. Integrated Circuit Replacement and Adjustment

IC replacement and adjustment is basically the same as with the AE-1, with some differences. Refer to the AE-1 Repair Guide. The OPT offset adjustment is the same as the PX-1 offset adjustment of the AE-1; but the osillator adjustment of the OSC/Interface IC and the AD/NULL adjustment of the Input IC directly affect the finder display and shutter timing and flash synchronization. They should be checked well whenever an IC is changed.

IC Removal and Replacement Tool

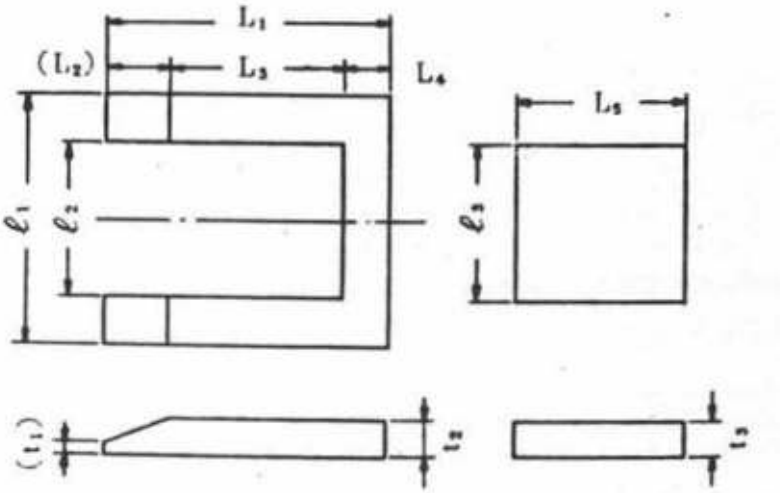
This soldering aid is simple to build and use. It greatly reduces repair caused failures. We recommend that each shop make at least one of each.



Note: The taper makes the tool easier to insert under the flex.

Fig. 4-1

Copper Plate Dimensions:
14.0 x 55.0;t=0.3mm



IC Installation End IC Removal End

	CPU	INPUT OSC
L_1	20.0	14.0
(L_2)	5.5	3.0
L_3	11.5	9.0
L_4	3.0	2.0
L_5	8.0	6.0
ℓ_1	15.0	11.0
ℓ_2	9.0	5.0
ℓ_3	6.0	4.5
(t_1)	0.5	0.5
t_2	1.5	1.5
t_3	3.0	3.0

Unit: mm

4.1 OPT IC Adjustment

1. Offset voltage check

   1) Desolder one end of resistor RTC.
   2) Short OPT pin 7 (Σ) to 8 (MOS OUT).
   3) Measure the voltage from pin 6 (TP) to ground (V1).
   4) Measure the voltage from pin 8 (MOS OUT to ground (V2)
   5) If V2 is within ±0.2 mV of V1, no adjustment is necessary.

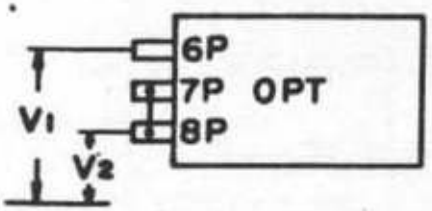


Fig. 4-2

2. Offset Adjustment

If V2 is not within 0.2 mV of V1, adjust in the following manner.

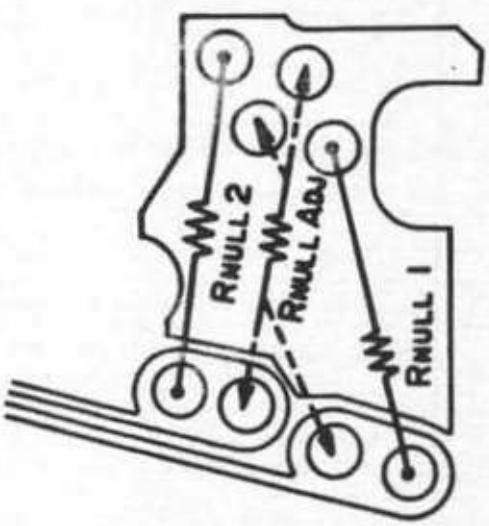


Fig. 4-3

   1) Remove resistor R NULL ADJ. and replace it temporarily with an approximately 30KΩ variable resistor.
   2) Adjust the variable resistor until V1 and V2 are within ±2 mV of each other.

3) Disconnect the variable resistor and read its resistance.

4) Install a fixed resistor with a resistance a near as possible to the variable resistors.

5) Recheck the voltage with the new resistor installed.

3. Offset Post-Adjustment Procedure

1) Remove the short between pins 7 and 8.

2) Resolder the resistor RTC leg unsoldered in 4.1.1.2.

3) Coat the OPT IC with moisture proofing compound.

4.2 OSC INTERFACE IC Adjustment

1. ROSC Check

There are two check methods for checking the oscillator depending on the test equipment available.
A frequency counter is prefered, but a shutter tester can be used in a frequency counter is not available.

Frequency Counter Method

1) Attach the frequency counter between the camera ground (body earth) and the CLK Pad (Fig. 2-28) and read the oscillator frequency.

2) The limits are 30,117 to 34,134 Hz. If it is within the limits, no adjustment is necessary.

Shutter Tester Method

1) Set the camera to TV Priority and 1/60 sec. shutter.

2) Check the shutter speed. If it is within the range of 15 to 17 mS (1 mm slit width tester), no adjustment is necessary.

2. ROSC Adjustment

If the oscillator is not within limits, proceed as follows.

1) Remove the ROSC resistor and replace it temporarily with an approximately 200 KΩ variable resistor.

Note: X64-4511-000, used in the Repeatcorder L, is suitable.

3) Adjust the variable resistor until the oscillator is with the frequency limits. Remove the variable and measure it. Install a fixed resistor with a resistance as near as possible to the resistance of the variable.

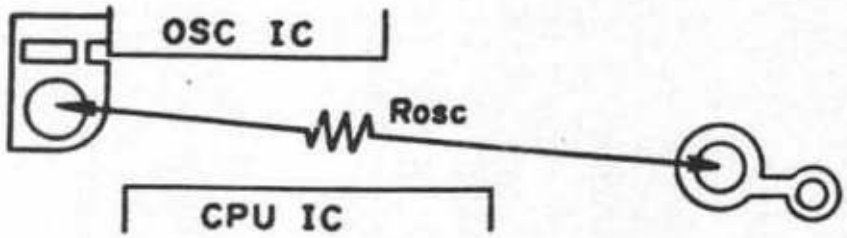


Fig. 4-4

4) Recheck the frequency with the new resistor installed.

3. RISET Check and Adjustment

This adjustment adjust the constant current supply for magnets Mg1 and Mg3 to 8 mA.

1) Remove the black lead from the 2nd curtain magnet (Mg3) and install a milliammeter in the line.

2) Release the shutter at bulb "B" and read the ammeter. The current should be 8 mA ± 10%.

3) If the current is not within the limit, replace the RISET resistor, which is normally about 4.5 KΩ, with one which will bring the current into the limits. (A lower resistance resistor will increase the current).

4.3 INPUT IC Adjustment (A/D NULL Adjustment)

1. Short CAD(-) and CAD(+). (Fig. 4-5)

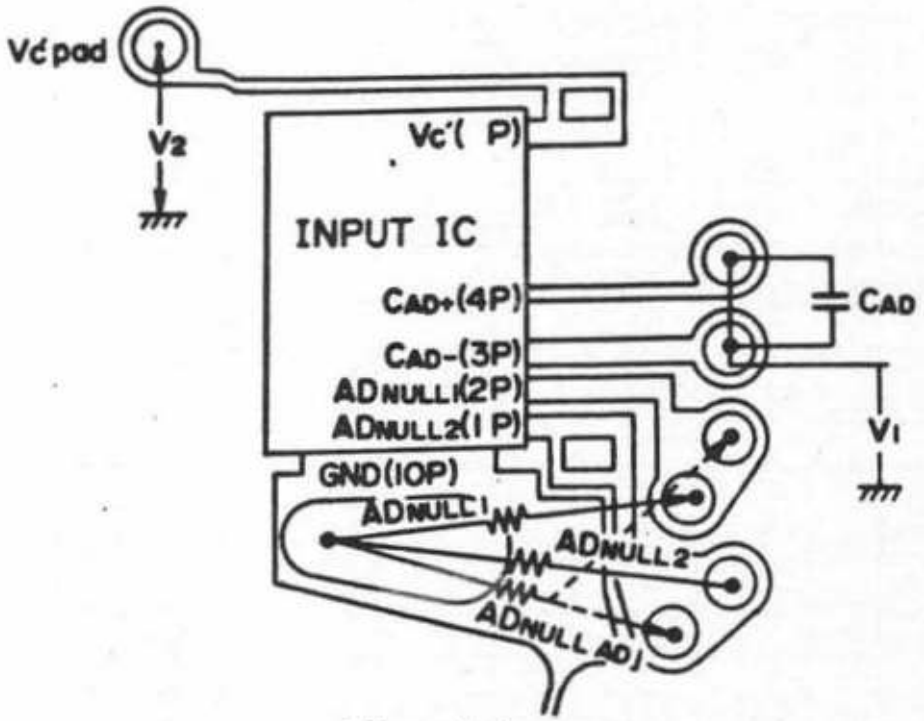


Fig. 4-5

2. Measure the voltage from CAD to ground (V1).

3. Measure the voltage from VC' pad to ground (V2).

4. V1 and V2 should be within 0.1 mV of each other. If they are not, the NULL adjustment must be made.

   Adjustment: ADNUL ADJ. Resistor (Normally approx. 20KΩ)

   Method: Identical to the OPT IC OFFSET adjustment.

   Note: If the following are correct, the A/D NULL is normally correct.

   i) If the SPC output is correctly adjusted by VRG and VRL (Section 2-21), or,

   ii) If the camera stops down to the correct flash-commanded aperture when using the 199A.

4.4 DECODER DRIVER IC Adjustment

RIADJ.

RI Adjustment adjust the constant current source for the viewfinder display segment LED's. It affects the brightness of the display.

SERVICE ADJUSTMENT

The factory adjustment requires tools, test equipment and IR soldering techniques not available to service facilities. The criteria for service will be the brightness as visually determined by the repair person.

If the display is too bright or dark, replace RIADJ (Fig. 4-6). A higher resistance will reduce the brightness.

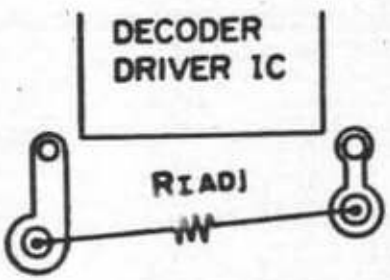


Fig. 4-6

SERVICE TOOLS LIST

CANON A-1

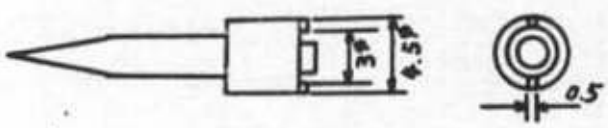
(REF. No. C12-1601)

TEST EQUIPMENT

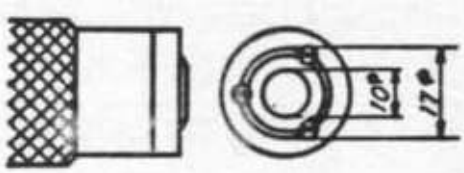
MEASURING ITEM		TEST EQUIPMENTS
1. Shutter	1-1	Shutter Tester Model 7J-18C (SU-018) or Equivalent
	1-2	Drum Shutter Tester
2. Exposure	2-1	Canon Light Source (SU-001-2)
	2-2	D.C. Voltage Tester Degital Tester VOAC707 (SD-004-2) or Accuracy Voltage Measuring Unit 1 mV.
	2-3	Standard Brightness Checker (SU-003-2) or Luminance Meter
	2-4	Ohm Meter
	2-5	EE Camera Tester Model 4P-27C-2 (SS-003-4), CEE-1AC or Equivalent.
	2-6	Bus Checker (SE-164)
	2-7	SV Check Bit Tool-1S (SE-165)
	2-8	Oscilloscope
3. Range View-finder	3-1	Universal Range-Viewfinder Collimator (SU-006-2) or Universal Range-finder Collimator
4. Mirror for 45°	4-1	Universal Type 90° Collimator
5. Field of View	5-1	Universal Range-Viewfinder Collimator (SU-006-2) or Universal Parallax Collimator

6. Flange	6-1	42, 14 Dial Gauge
7. Adjustment	7-1	Torque Gague (2000 ~ 7000 gcm) (SC-004)
	7-2	Depth Gague (Check to Max Aperture Correction Pin)
	7-3	Torque Gague Head ST42-C12-1401-1S (SE-138)
	7-4	Retaining Ring Plier AOG (SE-142)
	7-5	AE Evaluation Standard Lens (SE-153)
	7-6	160 Winding Lever Tightening Tool-1S (SE-166)
	7-7	Rewind Fork Knob-1S (SE-167)
	7-8	C12-1401 Test Battery Adapter (SE-143)
	7-9	Regulated D.C. Power Supply Model 532C (SD-001)

SPECIAL SCREWDRIVER USE	LOCAL PURCHASE
Tightening AT Dial	BT11-CA1-0948-1E

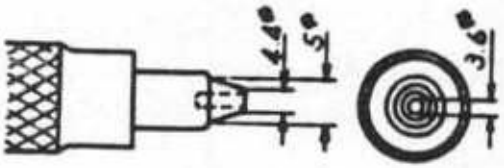


Tightening Shutter Button Ring	BZ99-13-4611-1T (Common to New Canonet QL)



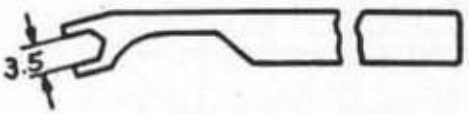
Tightening Syncro Terminal — BZ99-19-9509-1S

(Common to EF)



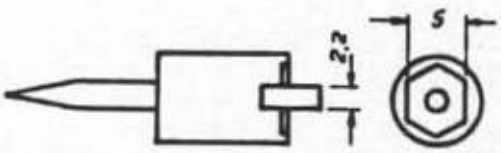
Mirror 45° Adjusting Spaner — TB11-CA1-4918-1S

(Common to AE-1)



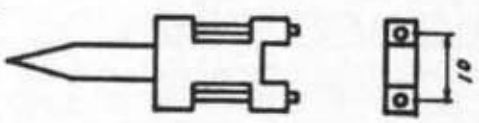
Tightening Sprocket Shaft — TB39-CS1-1768-1S

(Common to AE-1)



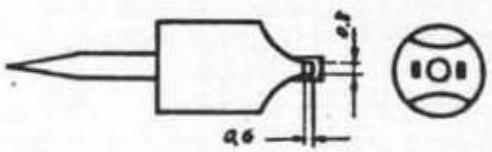
Tightening Winding Lever — TB39-CA1-4977-1S

(Common to AE-1)



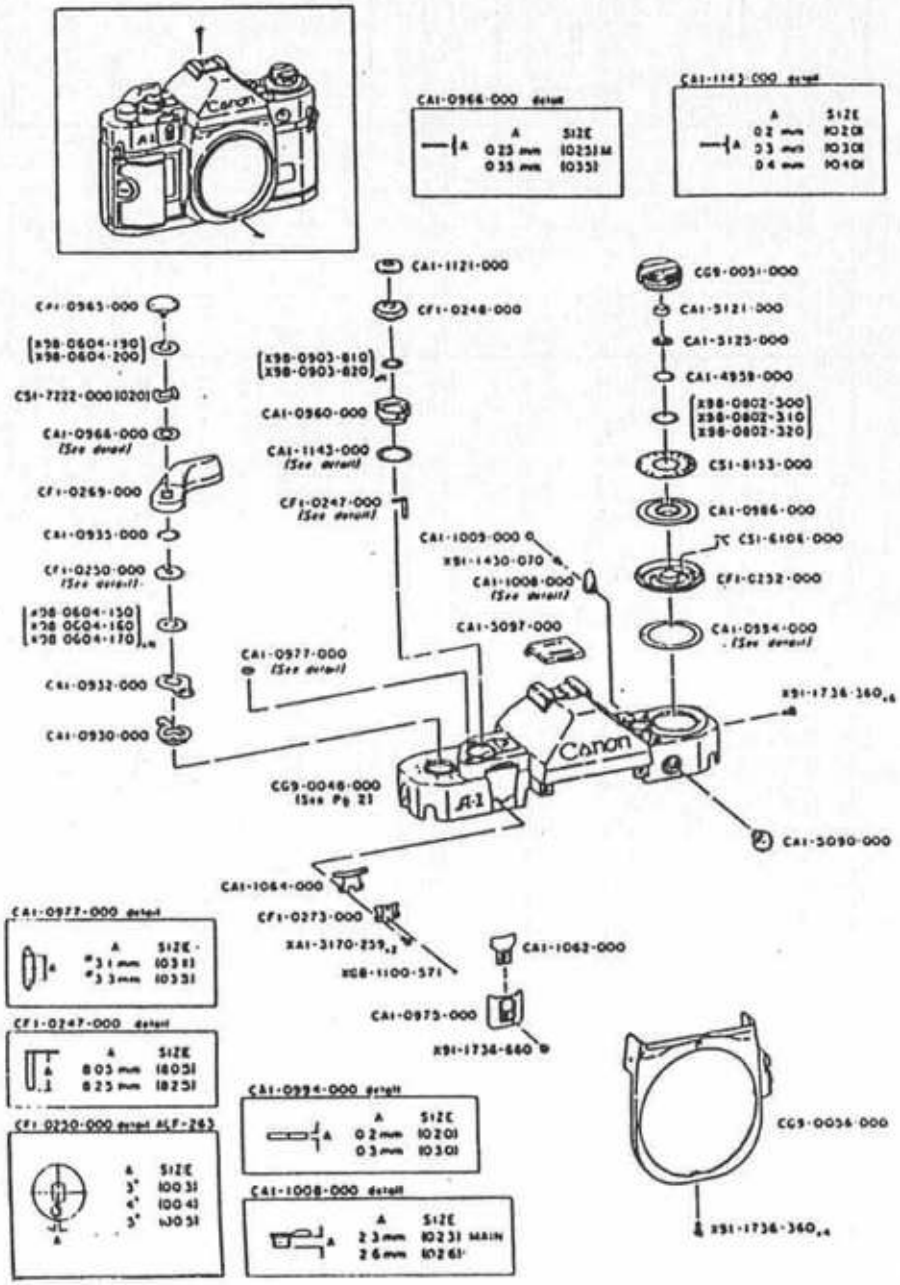
Tightening Sprocket Gear — TB39-CS2-0356-1S

(Common to AE-1)



CANON A-1

REF. NO. C12-1601

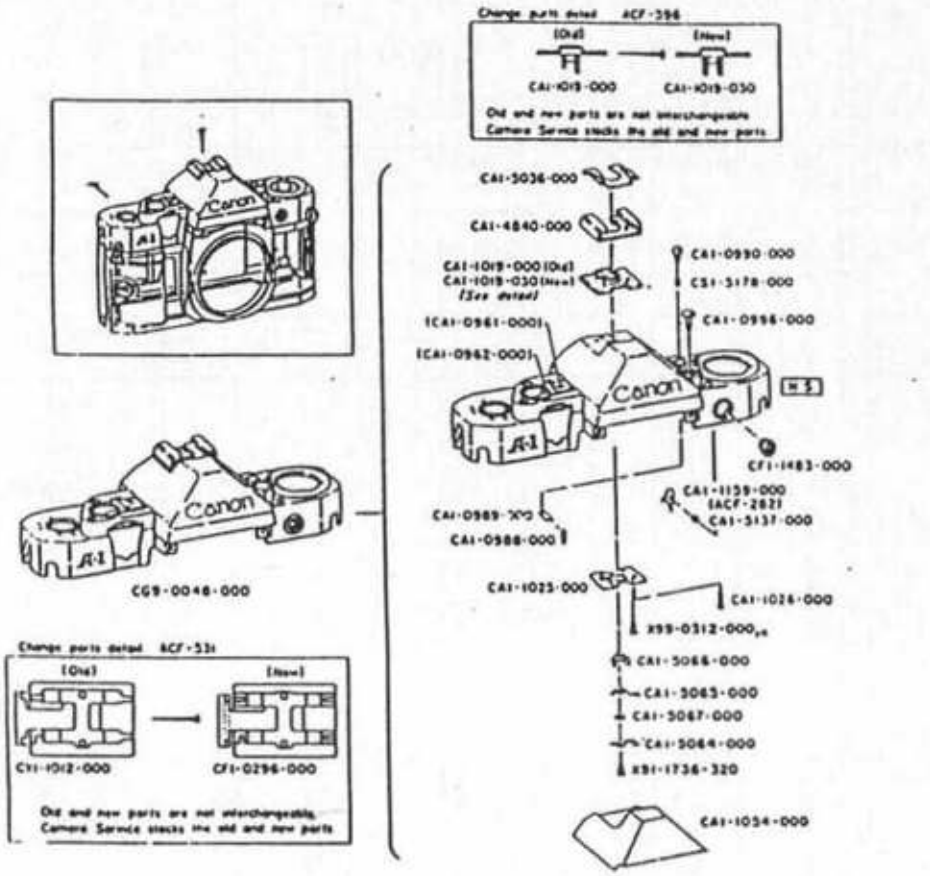


REF.NO.C12-1601

PARTS LIST

LEVER WINDING & REWIND CRANK UNIT

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-0930-000	B	1	LEVER, WE
	CA1-0932-000	B	1	LEVER, CNTL
	CA1-0935-000	D	1	C RING
	CA1-0960-000	B	1	LEVER, A/T CHANGE
	CA1-0965-000	A	1	SCREW, PIN FACE
	CA1-0966-000	D	1	WASHER
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-0975-000	B	1	COVER, SLIDER
	CA1-0977-000	B	1	COVER, LED
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-0986-000	C	1	LOCK PLATE, ASA
	CA1-0994-000	C	1	SPACER
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-1008-000	B	1	LEVER, EYEPIECE
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-1009-000	A	1	COVER
	CA1-1062-000	C	1	SLIDER
	CA1-1064-000	C	1	BRACKET
	CA1-1121-000	E	1	COVER, BUTTON
	CA1-1143-000	E	1	WASHER, ADJUSTING
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-4959-000	C	1	C RING
	CA1-5090-000	B	1	CAP, PC TERMINAL
	CA1-5097-000	A	1	COVER, HOT SHOE
	CA1-5121-000	C	1	COLLAR, RUBBER
	CA1-5125-000	B	1	STOPPER
	CF1-0247-000	C	1	SEAT, BUTTON
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CF1-0248-000	E	1	BUTTON, RELEASE
	CF1-0250-000	D	1	SEAT, WINDING
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CF1-0252-000	C	1	DIAL, ASA
	CF1-0269-000	B	1	LEVER, WINDING
	CF1-0273-000	C	1	BASE, CLICK
	CG9-0048-000	B	1	TOP COVER UNIT
	CG9-0051-000	B	1	REWIND CRANK UNIT
	CG9-0056-000	B	1	FRONT COVER UNIT
	CS1-6106-000	E	1	SPRING
	CS1-7222-000 (020)	D	1	WASHER, SPRING
	CS1-8153-000	C	1	PLATE, ASA
	XG8-1100-571		1	BALL, STEEL
	XA1-3170-239		2	SCREW, CROSS-RECESS, FCH
	X91-1430-070		1	SCREW, CROSS-RECESS, PH
	X91-1736-360		10	SCREW, CROSS-RECESS, PH
	X91-1736-660		1	SCREW, CROSS-RECESS, PH
	X98-0604-130		M	WASHER
	X98-0604-160			
	X98-0604-170			
	X98-0604-190		1	WASHER
	X98-0604-200			
	X98-0802-300		1	WASHER
	X98-0802-310			
	X98-0802-320			
	X98-0903-810		M	WASHER
	X98-0903-820			

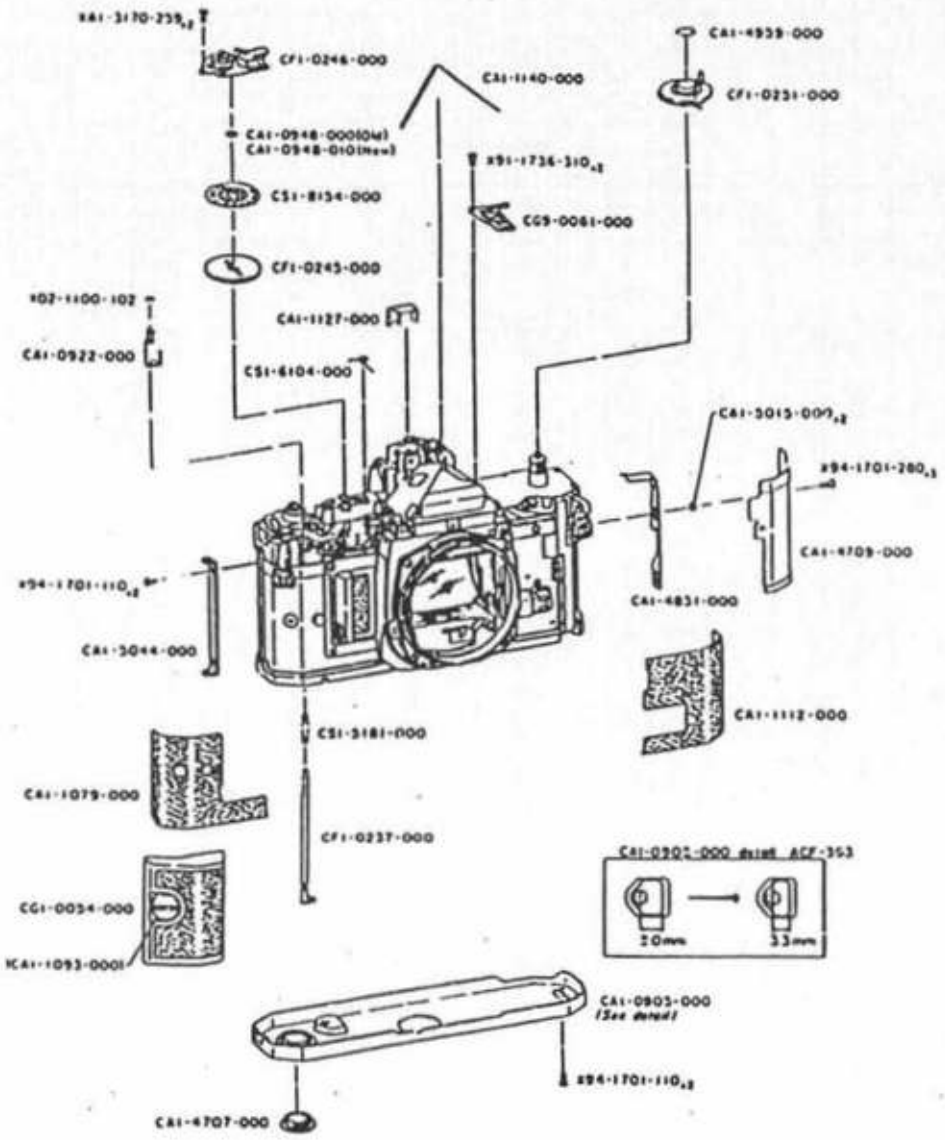


REF.NO.C12-1601

PARTS LIST

TOP COVER UNIT & BACK COVER UNIT

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	97-3644-000	D	1	COIL SPRING
	CA1-0961-000	C	1	*INDOW
	CA1-0962-000	C	1	*INDOW
	CA1-0988-000	E	1	PIN
	CA1-0989-000	E	1	LEVER, CONNECTION
	CA1-0990-000	E	1	BUTTON
	CA1-0996-000	D	1	BUTTON, B.C.
	CA1-1019-000	D	1	BASE, ACCESSORY SHOE
	CA1-1019-030	D	1	BASE, ACCESSORY SHOE
	CA1-1025-000	D	1	PLATE, MOUNTING
	CA1-1026-000	C	1	PIN
	CA1-1034-000	D	1	COVER
	CA1-1131-000	E	1	PLATE, NAME
	CA1-1133-000	C	1	ROLLER
	CA1-1159-000	C	1	CONTACT, P.C.
	CA1-3397-000	E	1	SHIELD, LIGHT
	CA1-4716-000	C	1	SHAFT, HINGE
	CA1-4840-000	C	1	SHOE, ACCESSORY
	CA1-5030-000	D	1	SHIELD, LIGHT
	CA1-5040-000	D	1	SHIELD, LIGHT
	CA1-5036-000	C	1	SPRING, PLATE
	CA1-5064-000	E		CONTACT, SHOE
	CA1-5065-000	E	1	CONTACT, SHOE
	CA1-5066-000	E	1	HOLDER, CONTACT
	CA1-5067-000	E	1	INSULATOR
	CA1-5074-000	C	1	SCREW, STOPPER
	CA1-5137-000	D	1	INSULATOR
	CA1-5152-000	C	1	SHAFT, HINGE
	CA4-0838-000	C	1	SHIELD, LIGHT
	CF1-0296-000	D	1	PRESSURE PLATE UNIT
	CF1-1483-000	E	1	TERMINAL, PC
	CG1-0055-000	B	1	BACK COVER UNIT
	CG9-0048-000	B	1	TOP COVER UNIT
	CS1-5178-000	E	1	SPRING, COIL
	CY1-1012-000	D	1	PRESSURE PLATE UNIT
	X91-1736-320		1	SCREW, CROSS-RECESS, PH
	X99-0312-000		4	SCREW, CROSS-RECESS, PH

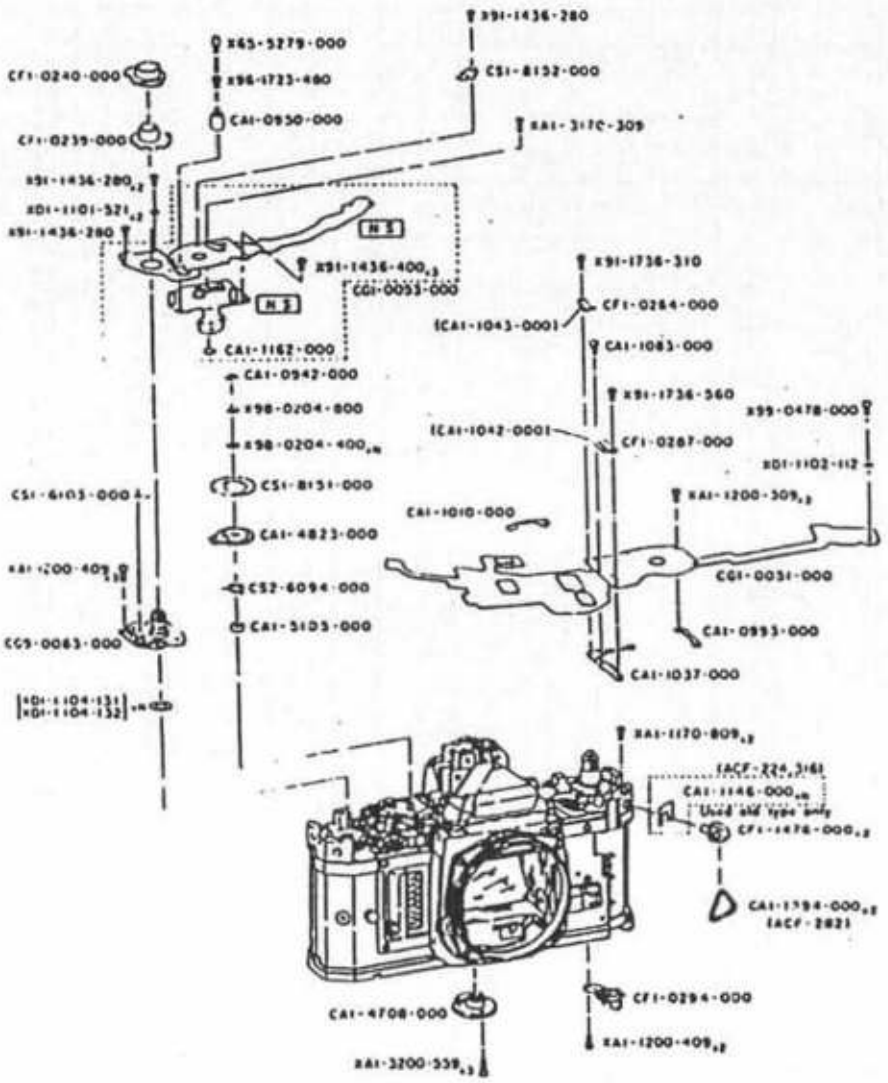


REF.NO.C12-1601

PARTS LIST

DIAL, A/T & COVER, BASE

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-0903-000	B	1	COVER, BASE
	CA1-0922-000	C	1	BRACKET, ME
	CA1-0948-000	C	1	NUT (P=0.5)
	CA1-0948-000	C	1	NUT (P=0.35)
	CA1-1079-000	A	1	LEATHER
	CA1-1093-000	B	1	SCREW
	CA1-1112-000	A	1	LEATHER
	CA1-1127-000	D	1	SPACER
	CA1-1140-000	C	1	BAND, RUBBER
	CA1-4707-000	B	1	COVER, COUPLING
	CA1-4709-000	D	1	COVER, BODY
	CA1-4831-000	E	1	HOOK
	CA1-4959-000	C	1	C RING
	CA1-5015-000	C	2	COLLAR
	CA1-5044-000	E	1	BRACKET, HINGE SHAFT
	CF1-0237-000	C	1	SHAFT, ME
	CF1-0245-000	C	1	DIAL, A/T
	CF1-0246-000	C	1	BASE A/I
	CF1-0251-000	C	1	CONATCT, ASA
	CG1-0034-000	B	1	ACTION GRIP ASSEMBLY
	CG9-0061-000	C	1	CONTACT UNIT
	CS1-5181-000	D	1	SPRING
	CS1-6104-000	D	1	SPRING
	CS1-8154-000	C	1	INDICATOR, A/T
	XA1-3170-259		2	SCREW, CROSS-RECESS, FCH
	XD2-1100-102		1	E RING
	XB1-1736-310		2	SCREW, CROSS-RECESS, PH
	XB4-1701-110		4	SCREW, CROSS-RECESS, FCH
	XB4-1701-280		3	SCREW, CROSS-RECESS, FCH



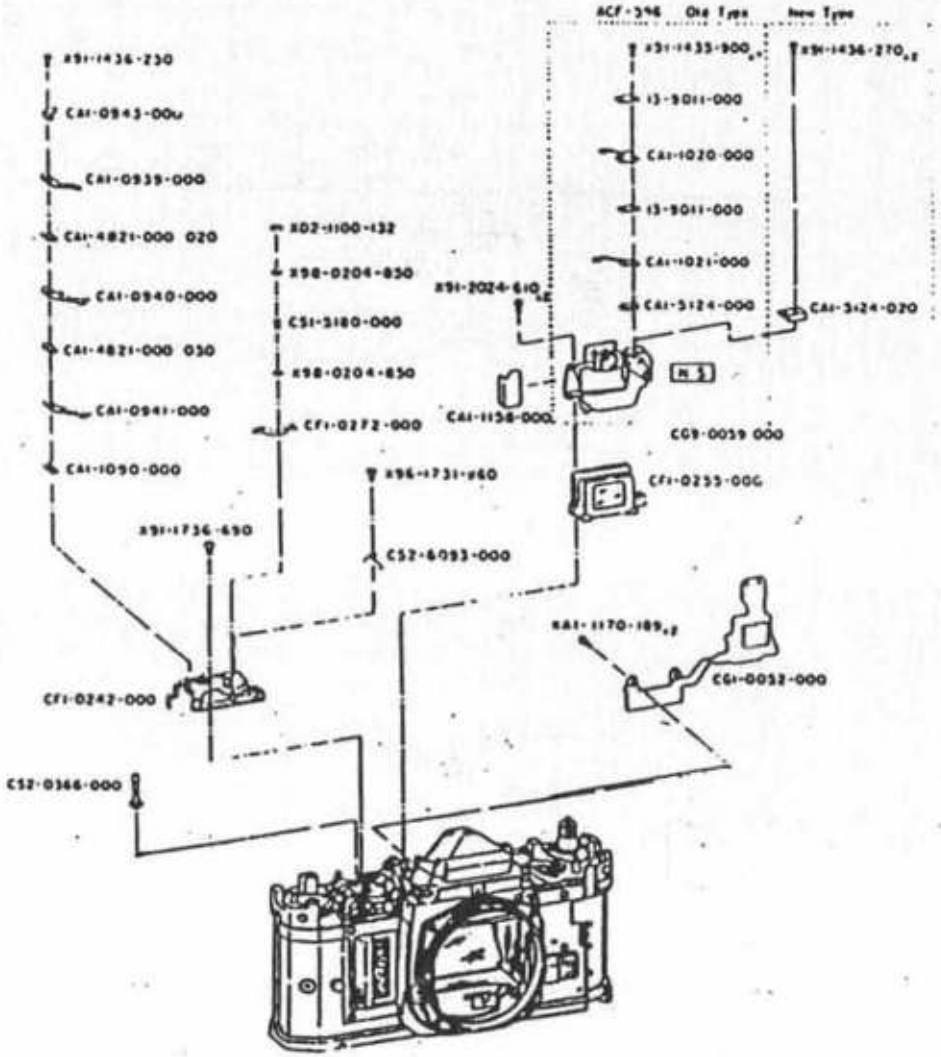
PARTS LIST

ELECTRIC PARTS UNIT & WINDING UNIT

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-0942-000	E	1	C RING
	CA1-0950-000	E	1	HOLDER, LED
	CA1-0993-000	E	1	SEAT, ASA
	CA1-1010-000	E	1	HOLDER, SPC
	CA1-1037-000	E	1	BASE, CONNECTOR
	CA1-1042-000	C	1	RUBBER
	CA1-1043-000	E	1	RUBBER
	CA1-1083-000	D	1	SCREW, SHOULDER
	CA1-1146-000	E	1	SPACER
	CA1-1162-000	D	1	INDICATOR
	CA1-1394-000	B	2	ADAPTER, NECK STRAP
	CA1-4708-000	D	1	SOCKET, TRIPOD
	CA1-4823-000	C	1	GEAR, FILM COUNTER
	CA1-5105-000	D	1	COLLAR
	CF1-0239-000	C	1	COUPLER, CNTL
	CF1-0240-000	D	1	COUPLER, ME
	CF1-0264-000	D	1	CONNECTOR B
	CF1-0287-000	D	1	CONNECTOR C
	CF1-0294-000	D	1	PD, TERMINAL
	CF1-1476-000	C	2	LUG, NECK STRAP
	CG1-0031-000	B	1	ELECTRIC PARTS UNIT
	CG1-0053-000	D	1	AT FLE UNIT
	CG9-0063-000	C	1	WINDING UNIT
	CS1-6103-000	D	1	SPRING
	CS1-8151-000	D	1	FILM COUNTER
	CS1-8132-000	D	1	INDICATER, FILM COUNTER
	CS2-6094-000	D	1	SPRING
	XA1-1170-809		2	SCREW, CROSS-RECCESS, PH
	XA1-1200-309		2	SCREW, CROSS-RECCESS, PH
	XA1-1200-409		5	SCREW, CROSS-RECCESS, PH
	XA1-3170-309		1	SCREW, CROSS-RECCESS, FCH
	XA1-3200-559		3	SCREW, CROSS-RECCESS, FCH
	X01-1101-521		2	WASHER
	X01-1102-112		1	WASHER
	X01-1104-131		N	WASHER
	X01-1104-132			
	X65-5279-000		1	LED
	X91-1436-280		4	SCREW, CROSS-RECCESS, PH
	X91-1436-400		3	SCREW, SLOTTED, FFH
	X91-1736-310		1	SCREW, CROSS-RECCESS, PH
	X91-1736-560		1	SCREW, CROSS-RECCESS, PH
	X96-1723-480		1	SCREW, SLOTTED, SHOULDER
	X98-0204-400		N	WASHER
	X98-0204-800		1	WASHER
	X99-0478-000		1	SCREW, CROSS-RECCESS, PH

CANON A-1

REF NO C12-1601



REF.NO.C12-1601

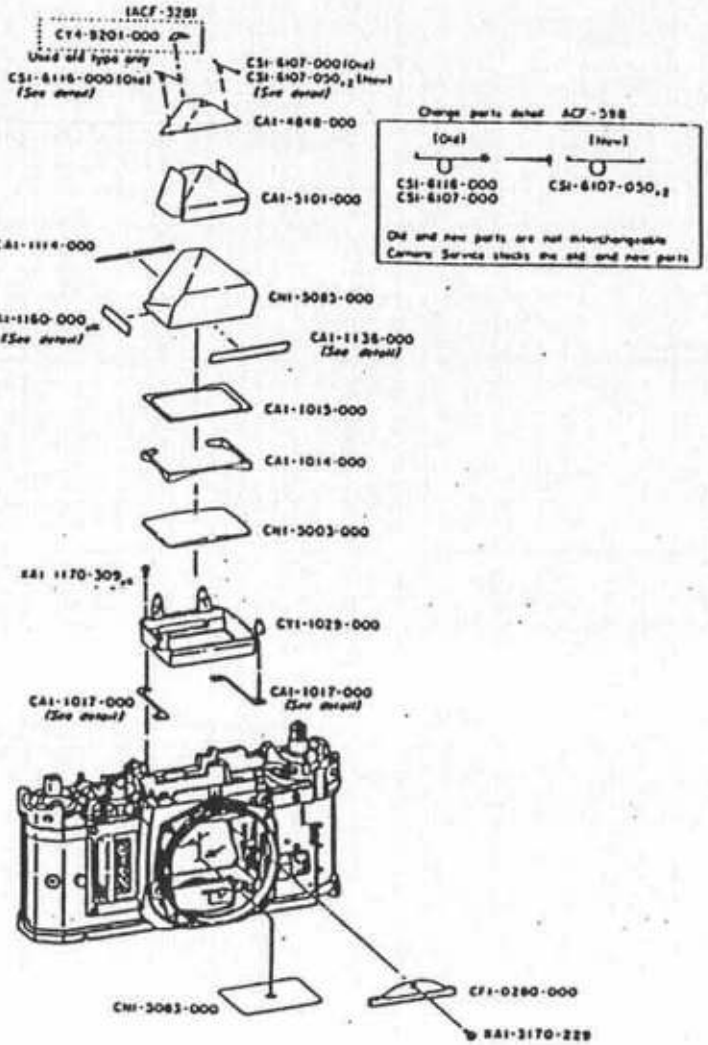
PARTS LIST

SPC HOLDER ASSEMBLY & EYEPIECE

MARK	PART NO.	CLASS	Q'TY	DESCRIPTION
	13-9011-000	D	2	INSUL..3R
	CA1-0939-000	C	1	CONTACT, EARTH
	CA1-0940-000	C	1	CONTACT, Sw 1
	CA1-0941-000	C	1	CONTACT
	CA1-0943-000	C	1	HOLDER
	CA1-1020-000	C	1	CONTACT
	CA1-1021-000	C	1	CONTACT
	CA1-1090-000	D	1	BASE, CONTACT
	CA1-1158-000	D	1	SHIELD, LIGHT
	CA1-4821-000 020	C	1	INSULATOR
	CA1-4821-000 030	C	1	INSULATOR
	CA1-5124-030	C	1	BASE, CONTACT
	CA1-5124-020	E	1	BASE, GUARD
	CF1-0242-000	C	1	BASE, FILM COUNTER
	CF1-0255-000	B	1	EYEPIECE
	CF1-0272-000	D	1	CONTACT, Sw 3
	CG1-0032-000	B	1	O/O FLR UNIT
	CG9-0059-000	C	1	SPC HOLDER UNIT
	C51-5180-000	D	1	SPRING, COIL
	C52-0366-000	D	1	GEAR, FILM COUNTER
	C52-6093-000	D	1	SPRING
	KA1-1170-189		2	SCREW, CROSS-RECESS, PH
	X02-1100-132		1	E RING
	X91-1435-900		2	SCREW, CROSS-RECESS, PH
	X91-1436-270		2	SCREW, CROSS-RECESS, PH
	X91-1436-230		1	SCREW, CROSS-RECESS, PH
	X91-1436-270		2	SCREW, CROSS-RECESS, PH
	X91-1736-690		1	SCREW, CROSS-RECESS, PH
	X91-2024-610		2	SCREW, CROSS-RECESS, PH
	X96-1731-960		1	SCREW, CROSS-RECESS, SHOULDER
	X98-0204-850		2	WASHER

PARTS LIST

PENTAPRISM



CA1-1160-000 detail

A	SIZE
0.10 mm	10108
0.20 mm	10208
0.25 mm	10258
0.30 mm	10308
0.35 mm	10358

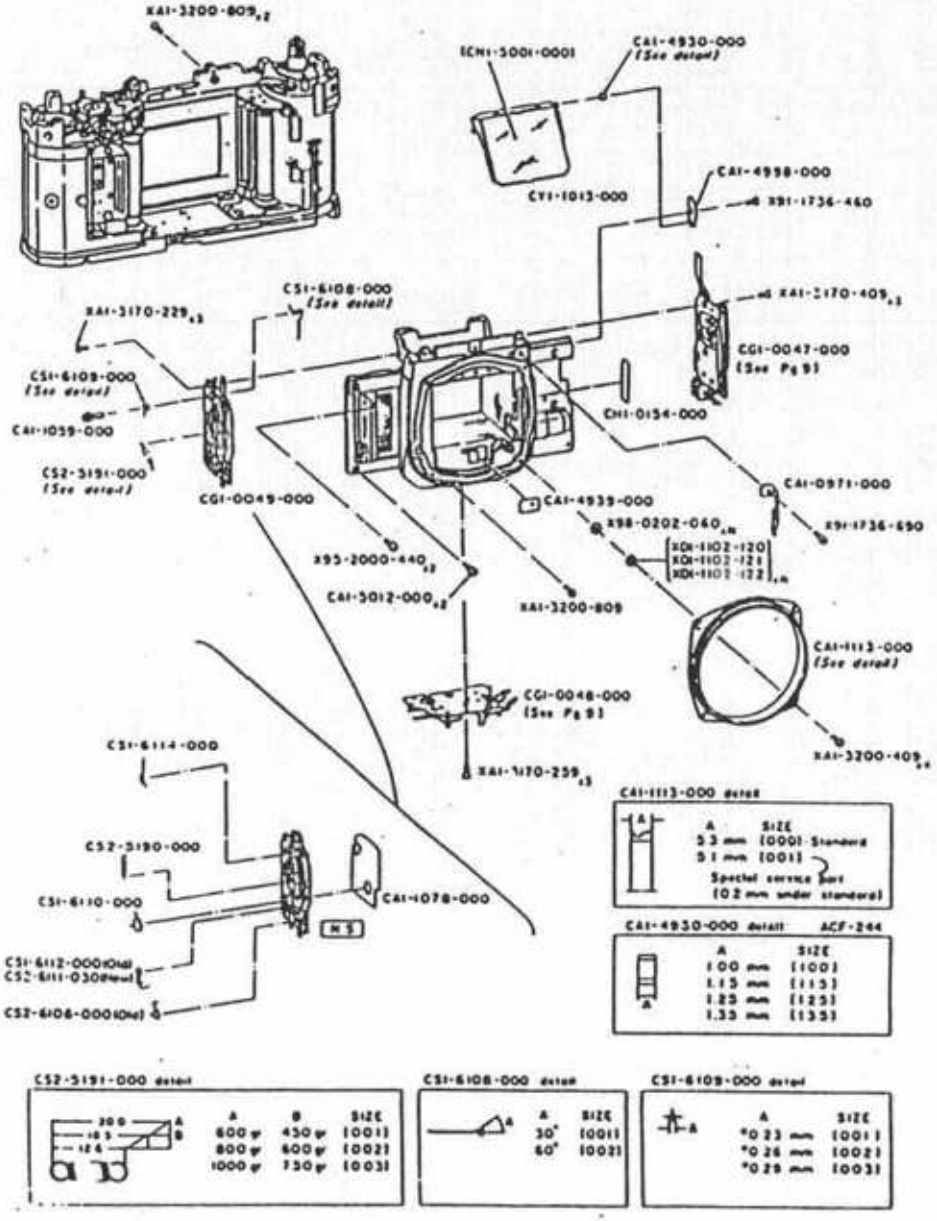
CA1-1017-000 detail ACF-259,268

A	SIZE
0.05 mm	10051
0.10 mm	10101
0.15 mm	10151
0.20 mm	10201
0.25 mm	10251
0.30 mm	10301

CA1-1136-000 detail ACF-274

A	SIZE
0.1 mm	10108
0.2 mm	10208
0.3 mm	10308

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-1014-000	E	1	SPACER
	CA1-1015-000	C	1	MASK, FINDER
	CA1-1017-000	D	2	WASHER, ADJUSTING
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-1114-000	E	1	SPACER
	CA1-1136-000	D	1	SPACER
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-1160-000	E	1	SPACER
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-4848-000	D	1	HOLDER, PENTAPRISM
	CA1-5101-000	D	1	COVER, PENTAPRISM
	CF1-0280-000	B	1	HOLDER
	CN1-5003-000	D	1	LENS, CONDENSER
	CN1-5083-000	D	1	SCREEN, FOCUSING
	CN1-5085-000	C	1	PENTAPRISM
	CS1-6107-000	E	1	SPRING
	CS1-6107-050	E	2	SPRING
	CS1-6116-000	D	1	SPRING
	CY1-1029-000	D	1	PENTAPRISM BOX UNIT
	CY4-9201-000		1	TAPE
	XA1-1170-309		4	SCREW, CROSS-RECESS, PH
	XA1-3170-229		1	SCREW, CROSS-RECESS, FCH



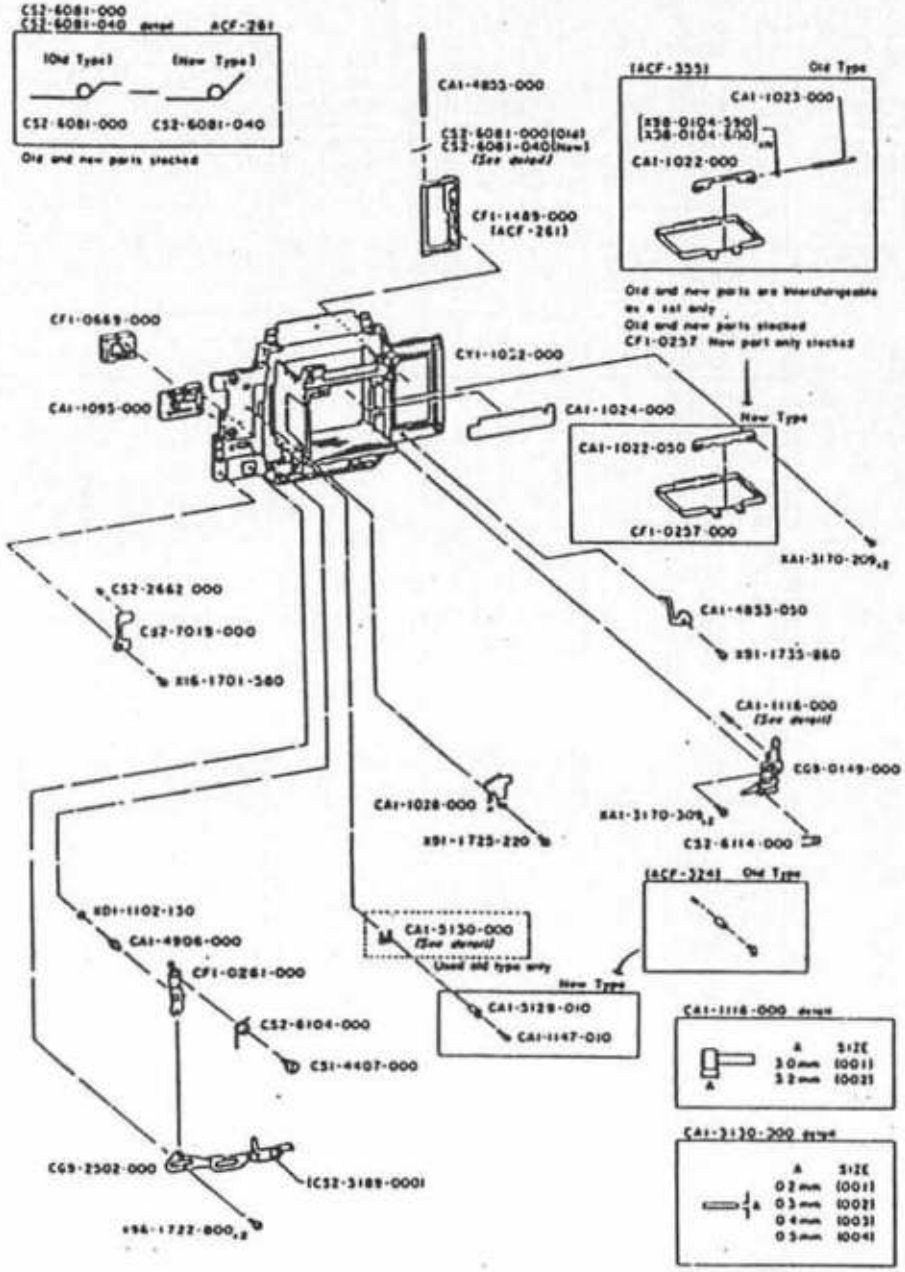
REF.NO.C12-1601

PARTS LIST

MIRROR UNIT & BODY MOUNT

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-0971-000	D	1	CONTACT
	CA1-1059-000	D	1	SCREW, SHOULDER
	CA1-1078-000	E	1	LIGHT SHIELD
	CA1-1113-000	B	1	BODY MOUNT
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-4930-000	D	1	COLLAR
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-4939-000	D	1	PLATE, INDICATOR
	CA1-4998-000	D	1	PLATE, ADJUSTING
	CA1-5012-000	C	2	SCREW, SHOULDER
	CG1-0047-000	C	1	AE UNIT
	CG1-0048-000	C	1	AUTO DIAPHRAGM UNIT
	CG1-0049-000	C	1	MIRROR QR UNIT
	CN1-0154-000	D	1	CONTACT, PRINTED
	CN1-5001-000	C	1	MIRROR
	CS1-6108-000	D	1	SPRING
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS1-6109-000	D	1	SPRING
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS1-6110-000	D	1	SPRING
	CS1-6112-000	D	1	SPRING
	CS1-6114-000	D	1	SPRING
	CS2-5190-000	D	1	SPRING, COIL
	CS2-5191-000	D	1	SPRING, COIL
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS2-6106-000	D	1	SPRING
	CS2-6111-030	D	1	SPRING
	CY1-1013-000	B	1	MIRROR UNIT
	XA1-3170-229		3	SCREW, CROSS-RECESS, FCH
	XA1-3170-259		3	SCREW, CROSS-RECESS, FCH
	XA1-3170-409		3	SCREW, CROSS-RECESS, FCH
	XA1-3200-409		4	SCREW, CROSS-RECESS, FCH
	XA1-3200-809		3	SCREW, CROSS-RECESS, FCH
	XD1-1102-120		N	WASHER
	XD1-1102-121			
	XD1-1102-122			
	X91-1736-460		1	SCREW, CROSS-RECESS, PH
	X91-1736-690		1	SCREW, CROSS-RECESS, PH
	X95-2000-440		2	SCREW, SLOTTED, OCH
	X98-0202-060		N	WASHER

8

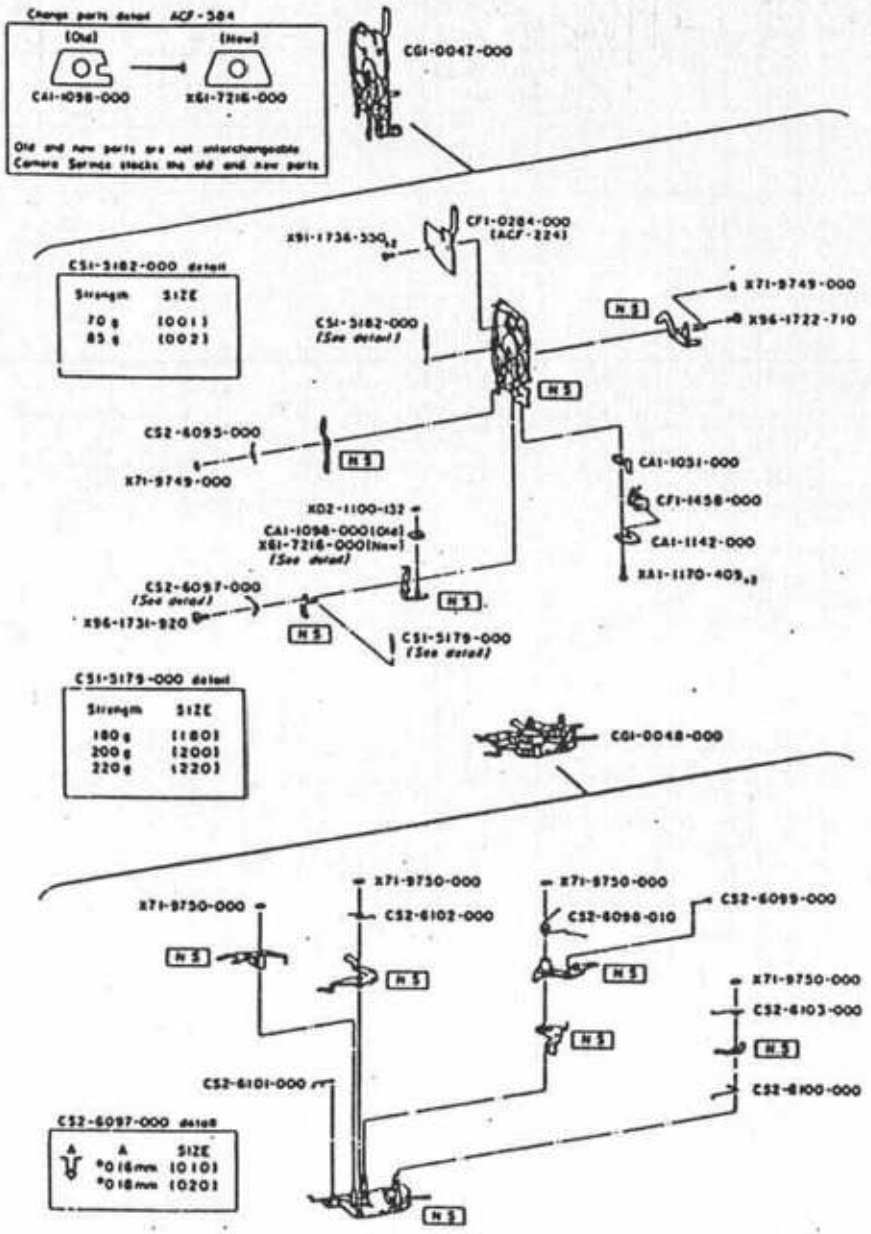


REF.NO.C12-1601

PARTS LIST

FRONT PANEL

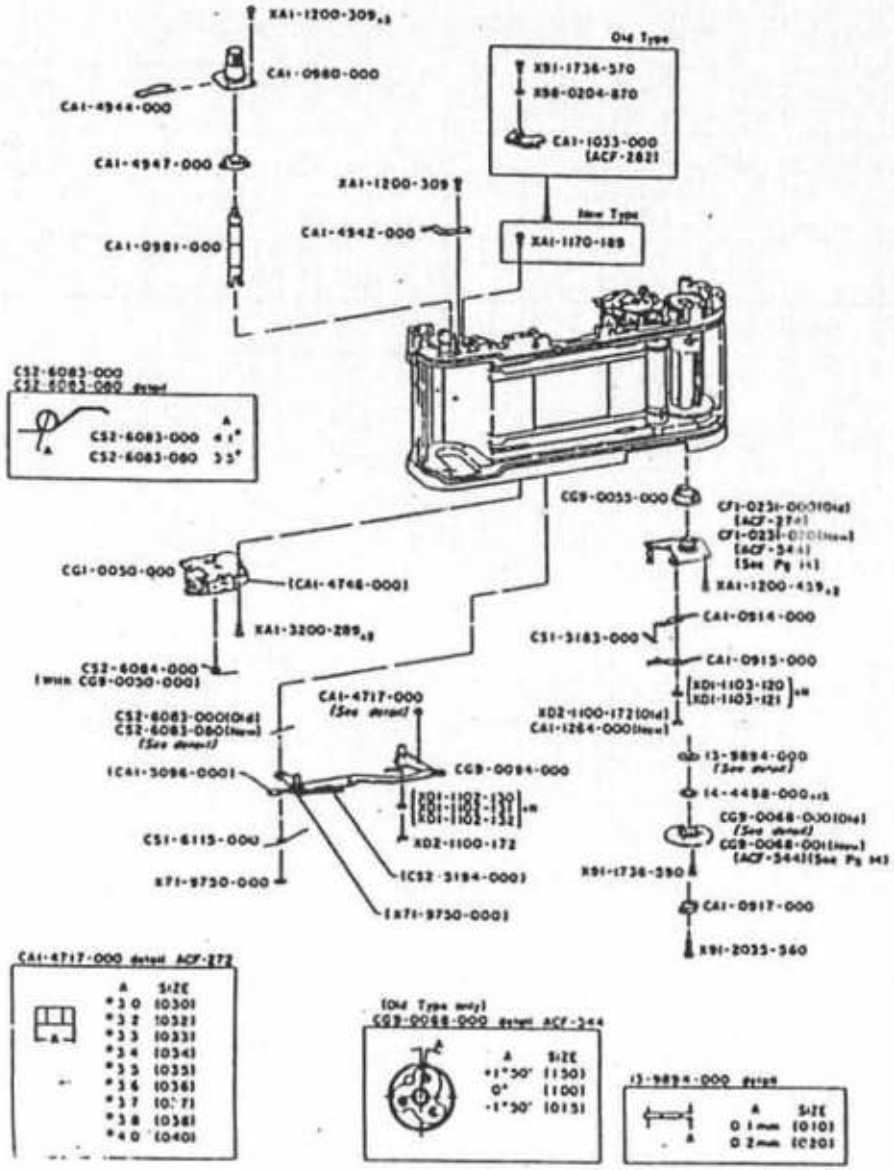
MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-1022-000	D	1	HOLDER, HINGE
	CA1-1022-050	E	1	HOLDER, HINGE
	CA1-1023-000	E	1	HINGE
	CA1-1024-000	D	1	LIGHT SHIELD
	CA1-1028-000	D	1	SWITCH, STOP-DOWN
	CA1-1095-000	D	1	BASE, STOP-DOWN LEVER
	CA1-1116-000	D	1	PIN A-M CHANGE
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-1147-010	E	1	SCREW, MAX. APERTURE CORRECTION
	CA1-4853-050	E	1	PLATE, SPRING
	CA1-4855-000	D	1	SHAFT, HINGE
	CA1-4906-000	E	1	SCREW, SHAFT
	CA1-5129-010	D	1	MAX APERTURE CORRECTION PIN
	CA1-5130-000	E	1	WASHER
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CF1-0257-000	D	1	HOLDER, FOCUSING SCREEN
	CF1-0261-000	E	1	LEVER, STOP-DOWN
	CF1-0669-000	B	1	KNOB, STOP-DOWN
	CF1-1489-000	B	1	COVER, BATTERY CHAMBER
	CG9-0149-000	D	1	CONTACT ASSEMBLY A-M
	CG9-2502-000	D	1	SLIDE LEVER UNIT
	CS1-4407-000	D	1	SCREW, SHOULDERR
	CS2-2662-000	D	1	BUTTON, LOCK RELEASE
	CS2-5189-000	D	1	SPRING, COIL
	CS2-6081-000	E	1	SPRING
	CS2-6081-040	E	1	SPRING
	CS2-6104-000	D	1	SPRING
	CS2-6114-000	E	1	SPRING
	CS2-7019-000	E	1	SPRING
	CY1-1032-000	E	1	FRONT PANEL
	XA1-3170-209		2	SCREW, CROSS RECESS, FCH
	XA1-3170-309		2	SCREW, CROSS RECESS, FCH
	XD1-1102-130		1	WASHER
	X16-1701-580		1	SCREW, CROSS-RECESS, PH
	X91-1725-220		1	SCREW, SLOTTED, FFH
	X91-1735-860		1	SCREW, CROSS-RECESS, PH
	X96-1722-800		2	SCREW, SLOTTED, SHOULDER
	X98-0104-590		N	WASHER
	X98-0104-600			



PARTS LIST

AE UNIT & AUTO DIAPHRAGM UNIT

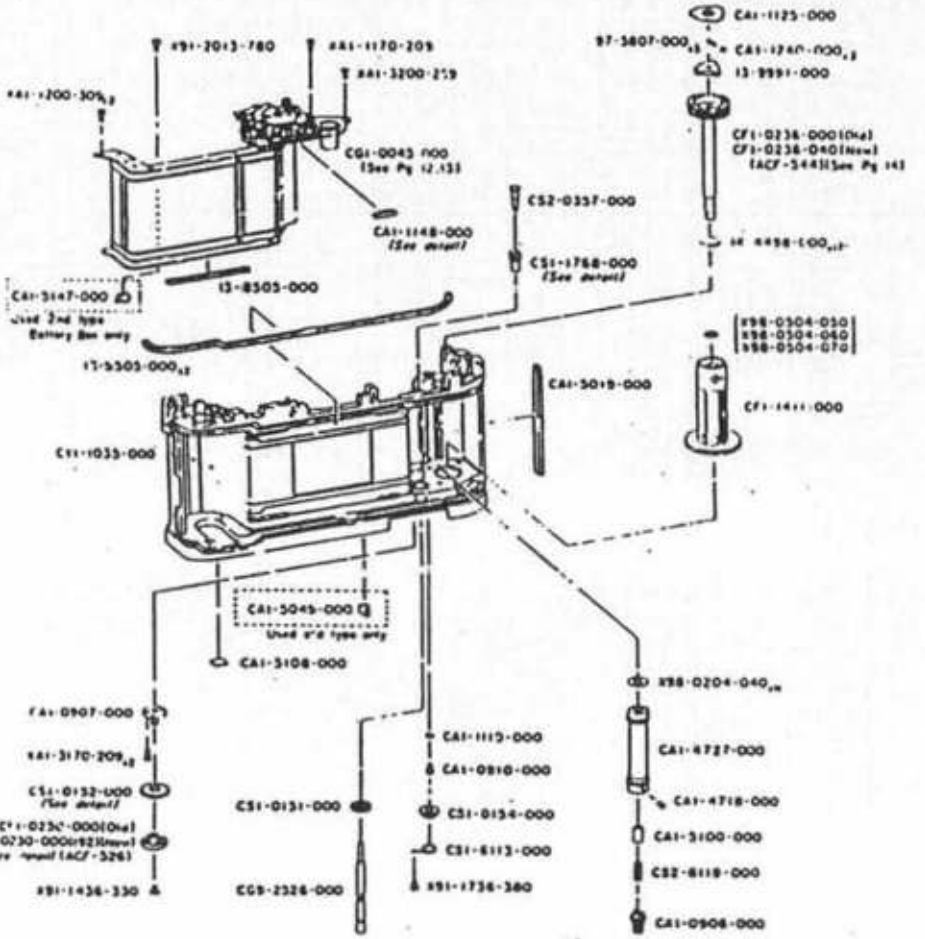
MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-1051-000	E	1	SPACER
	CA1-1098-000	D	1	ARMATURE
	CA1-1142-000	D	1	CORE, MAGNET
	CF1-0284-000	D	1	SAVE FLX
	CF1-1458-000	D	1	MAGNET, AE
	CG1-0047-000	C	1	AE UNIT
	CG1-0048-000	C	1	AUTO DIAPHRAGM UNIT
	CS1-5179-000	D	1	SPRING, COIL
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS1-5182-000	D	1	SPRING
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS2-6095-000	E	1	SPRING
	CS2-6097-000	D	1	SPRING
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS2-6098-010	E	1	SPRING
	CS2-6099-000	E	1	SPRING
	CS2-6100-000	E	1	SPRING
	CS2-6101-000	E	1	SPRING
	CS2-6102-000	E	1	SPRING
	CS2-6103-000	E	1	SPRING
	XA1-1170-409		2	SCREW, CROSS-RECESS, PH
	XD2-1100-132		1	E RING
	X61-7216-000	D	1	ARMATURE
	X71-9749-000		2	RETAINER
	X71-9750-000		4	RETAINER
	X91-1736-330		2	SCREW, CROSS-RECESS, PH
	X96-1722-710		1	SCREW, SLOTTED, SHOULDER
	X96-1731-920		1	SCREW, SLOTTED, SHOULDER

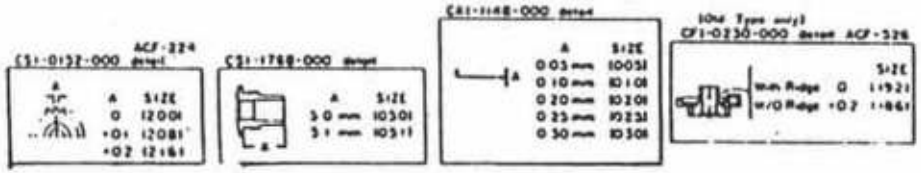


PARTS LIST

SHAFT, REWIND & CONNECTING LEVER UNIT

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	13-9894-000	D	1	WASHER
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	14-4498-000	C	13	BALL, STEEL
	CA1-0914-000	D	1	LEVER, REWIND ADVANCE A
	CA1-0915-000	D	1	LEVER, REWIND ADVANCE B
	CA1-0917-000	D	1	COUPLER, MD
	CA1-0980-000	E	1	HOLDER, REWIND SHAFT
	CA1-0981-000	B	1	SHAFT, REWIND
	CA1-1033-000	D	1	BASE, P.C.C. TERMINAL
	CA1-1264-000	E	1	C. RING
	CA1-4717-000	E	1	COLLAR
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-4746-000	E	1	COVER, DUST
	CA1-4942-000	E	1	SPRING, PLATE
	CA1-4944-000	D	1	SPRING, CLICK
	CA1-4947-000	C	1	LIFTER, HOOD
	CA1-5096-000	E	1	CAP
	CF1-0231-000	E	1	BASE, WINDING
	CF1-0231-070	E	1	BASE, WINDING
	CG1-0050-000	B	1	MAGNET UNIT
	CG9-0055-000	B	1	SPOOL GEAR ASS'Y
	CG9-0068-000	D	1	CHARGE GEAR UNIT
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CG9-0068-001	D	1	CHARGE GEAR UNIT
	CG9-0094-000	C	1	CONNECTING LEVER UNIT
	CS1-3183-000	D	1	SPRING, COIL
	CS1-6115-000	D	1	SPRING
	CS2-3194-000	E	1	SPRING, COIL
	CS2-6083-000	C	1	SPRING
	CS2-6083-080	C	1	SPRING
	CS2-6084-000	E	1	SPRING
	XA1-1170-189		1	SCREW, CROSS-RECESS, PH
	XA1-1200-309		4	SCREW, CROSS-RECESS, PH
	XA1-1200-439		2	SCREW, CROSS-RECESS, PH
	XA1-3200-289		2	SCREW, CROSS RECESS, FCH
	XD1-1102-130		M	WASHER
	XD1-1102-131			
	XD1-1102-132			
	XD1-1103-120		M	WASHER
	XD1-1103-121			
	XD2-1100-172		2	E RING
	X71-9750-000		2	RETAINER
	X91-1736-370		1	SCREW, CROSS-RECESS, PH
	X91-1736-590		1	SCREW, SLOTTED, FPH
	X91-2035-360		1	SCREW, CROSS-RECESS, PH
	X98-0204-870		1	WASHER



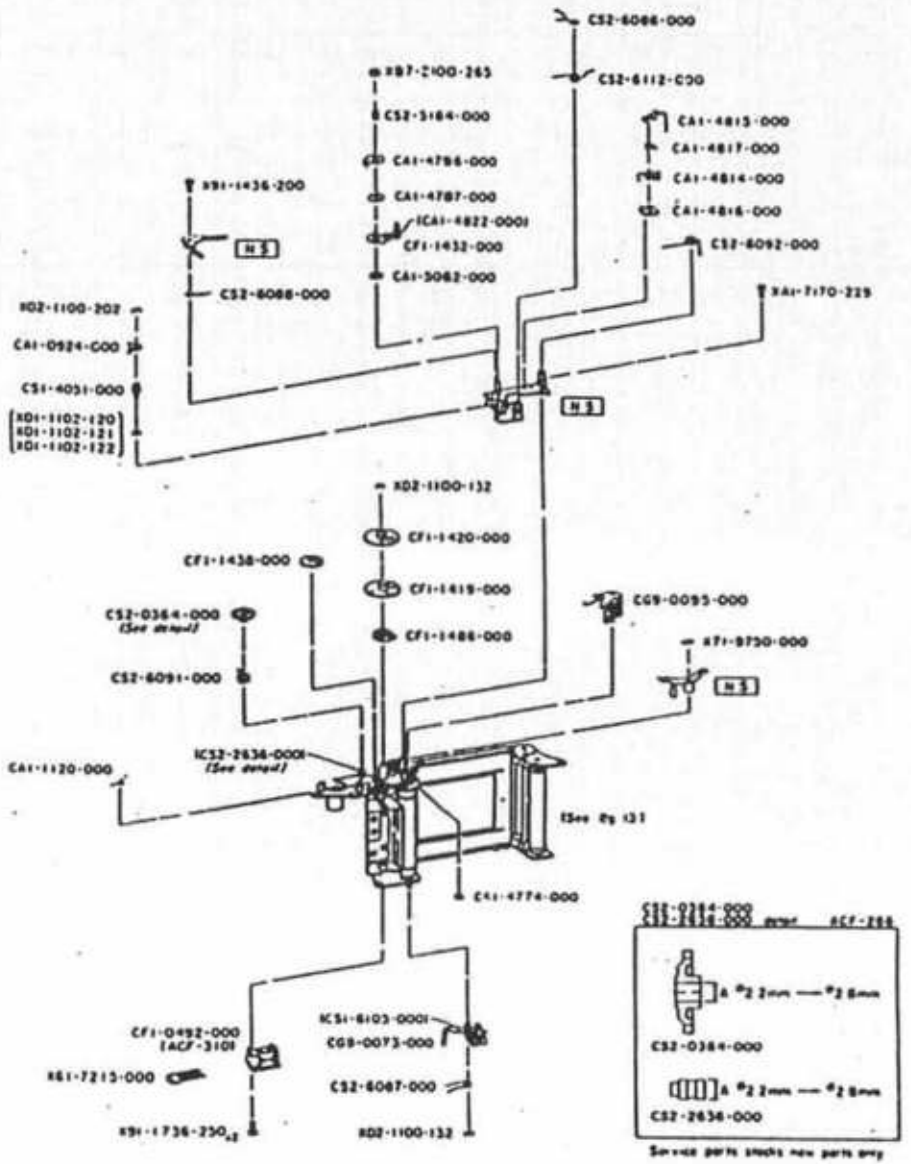


REF.NO.C12-1601

PARTS LIST

SPOOL & SPROCKET

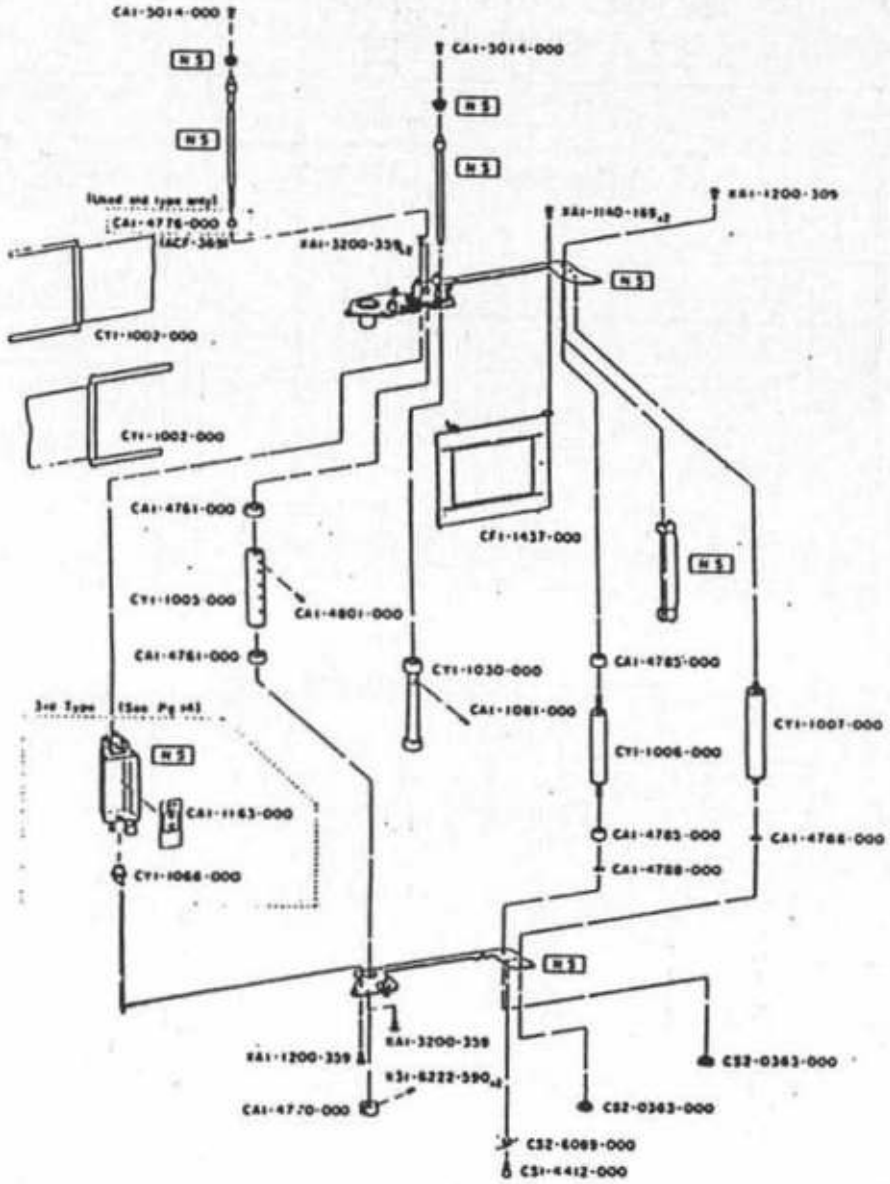
MARK	PART NO.	CLASS	QTY	DESCRIPTION
	13-8503-000	D	2	LIGHT SHIELD
	13-9991-000	D	1	CLUTCH CAM
	14-4498-000	C	17	BALL, STEEL
	97-3807-000	C	3	COIL SPRING
	CA1-0906-000	E	1	CLUTCH, SPROCKET
	CA1-0907-000	E	1	FLANGE, GEAR MOUNTING
	CA1-0910-000	E	1	STUD, IDLER
	CA1-1110-000	D	1	COLLAR, IDLER
	CA1-1125-000	D	1	PLATE, COVER
	CA1-1148-000	E	1	WASHER
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CA1-1240-000	D	3	ROLLER
	CA1-4718-000	D	1	SETSCREW
	CA1-4727-000	C	1	SPROCKET
	CA1-5019-000	E	1	LIGHT SHIELD
	CA1-5049-000	D	1	CUSHION
	CA1-5100-000	D	1	COLLAR
	CA1-5108-000	E	1	INSULATOR
	CA1-5147-000	E	1	CONTACT
	CF1-0230-000	E	1	BASE, CLUTCH
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CF1-0230-050 (192)	E	1	BASE, CLUTCH
	CF1-0236-000	C	1	SHAFT, WINDING
	CF1-0236-040	C	1	SHAFT, WINDING
	CF1-1411-000	E	1	SPOOL
	CG1-0045-000	C	1	SHUTTER UNIT
	CG9-2526-000	D	1	SHAFT, SPROCKET
	CS1-0131-000	E	1	GEAR, SPROCKET
	CS1-0132-000	D	1	GEAR, COMPOUND
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS1-0134-000	D	1	GEAR, IDLE
	CS1-1768-000	D	1	BUSHING, SPROCKET
	(ENTER SIZE WHEN ORDERING, SEE DETAIL)			
	CS1-6113-000	D	1	SPRING
	CS2-0357-000	D	1	GEAR, FILM COUNTER
	CS2-6119-000	E	1	SPRING, COIL
	CY1-1035-000	E	1	BODY
	#A1-1170-209		1	SCREW, CROSS-RECESS, PH
	#A1-1200-309		2	SCREW, CROSS-RECESS, PH
	#A1-3170-209		2	SCREW, CROSS RECESS, FCH
	#A1-3200-259		1	SCREW, CROSS RECESS, FCH
	#91-1436-330		1	SCREW, CROSS-RECESS, PH
	#91-1736-380		1	SCREW, CROSS-RECESS, PH
	#91-2013-780		1	SCREW, SLOTTED, FFH
	#98-0204-040	N		WASHER
	#98-0504-030	1		WASHER
	#98-0504-060			
	#98-0504-070			



PARTS LIST

SHUTTER UNIT PART 1

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-0924-000	D	1	LEVER
	CA1-1120-000	D	1	SPRING
	CA1-4774-000	E	1	NUT
	CA1-4787-000	E	1	PAD, BRAKE
	CA1-4796-000	E	1	WASHER
	CA1-4814-000	E	1	CONTACT, X
	CA1-4815-000	E	1	CONTACT, X
	CA1-4816-000	E	1	INSULATOR
	CA1-4817-000	E	1	INSULATOR
	CA1-4822-000	E	1	INSULATOR
	CA1-5062-000	D	1	WASHER, PULLEY
	CF1-0492-000	B	1	MAGNET, SHUTTER
	CF1-1419-000	E	1	GEAR
	CF1-1420-000	E	1	GEAR
	CF1-1432-000	E	1	BRAKE, 1ST CURTAIN
	CF1-1438-000	D	1	GEAR
	CF1-1486-000	E	1	GEAR
	CG9-0073-000	D	1	LEVER, 2ND CURTAIN RELEASE
	CG9-0095-000	D	1	2ND CURTAIN BRAKE UNIT
	CS1-4051-000	E	1	SCREW, SHOULDER
	CS1-6103-000	D	1	SPRING
	CS2-0364-000	D	1	GEAR, IDLER
	CS2-2636-000	E	1	STUD, IDLER
	CS2-5184-000	E	1	SPRING, COIL
	CS2-6086-000	E	1	SPRING, COIL
	CS2-6087-000	D	1	SPRING, COIL
	CS2-6088-000	E	1	SPRING, COIL
	CS2-6091-000	D	1	SPRING, COIL
	CS2-6092-000	E	1	SPRING, COIL
	CS2-6112-000	E	1	SPRING, COIL
	XA1-7170-229		1	SCREW, CROSS-RECESS, PH
	XB7-2100-265		1	NUT
	XD1-1102-120		1	WASHER
	XD1-1102-121			
	XD1-1102-122			
	XD2-1100-132		2	E RING
	XD2-1100-202		1	E RING
	XE1-7215-000		1	CORE, MAGNET
	XI1-9730-000		1	RETAINER
	XB1-1436-200		1	SCREW, SLOTTED, FH
	XB1-1736-250		2	SCREW, CROSS-RECESS, PH

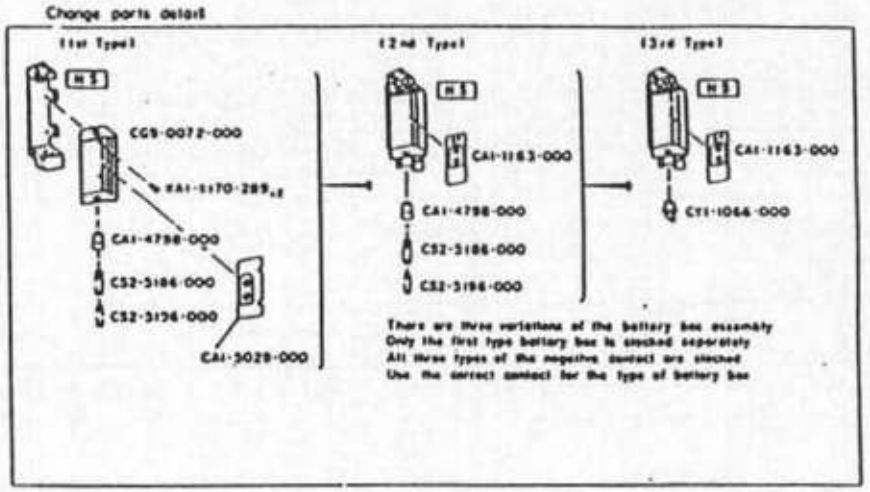


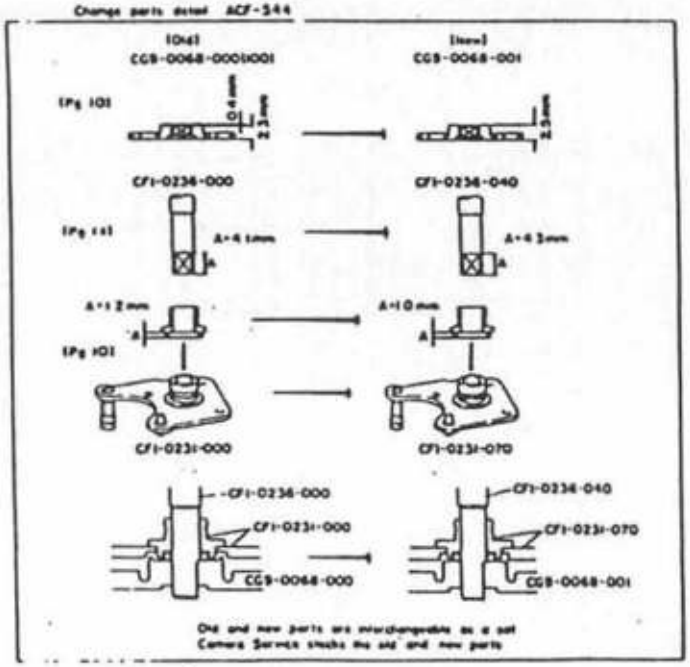
PARTS LIST

SHUTTER UNIT PART 2

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-1081-000	E	1	PIN, SPRING
	CA1-1163-000	D	1	SEAL, BATTERY
	CA1-4761-000	E	2	ROLLER, 1ST CURTAIN TAPE
	CA1-4770-000	E	1	CAM, CURTAIN LATCH
	CA1-4776-000	E	1	COLLAR
	CA1-4785-000	E	2	ROLLER, 2ND CURTAIN TAPE
	CA1-4788-000	E	2	WASHER
	CA1-4801-000	E	1	SCREW, ALIGNMENT PIN
	CA1-5014-000	C	2	SCREW
	CF1-1437-000	C	1	SHIELD, LIGHT
	CS1-4412-000	E	1	SCREW
	CS2-0363-000	D	2	GEAR
	CS2-6089-000	D	1	SPRING
	CY1-1002-000	C	1	CURTAIN, 1ST & 2ND
	CY1-1005-000	D	1	DRUM, 2ND CURTAIN
	CY1-1006-000	E	1	DRUM, 1ST CURTAIN
	CY1-1007-000	D	1	DRUM, 2ND CURTAIN
	CY1-1030-000		1	DRUM, 2ND CURTAIN
	CY1-1066-000	D	1	BATTERY CONTACT UNIT
	XA1-1140-169		2	SCREW, CROSS-RECESS, PH
	XA1-1200-309		1	SCREW, CROSS-RECESS, PH
	XA1-1200-359		1	SCREW, CROSS-RECESS, PH
	XA1-3200-359		3	SCREW, CROSS-RECESS, FCH
	X31-6222-590		2	SETSCREW, HEXAGON SOCKET, HLMP

14





REF.NO.C12-1601

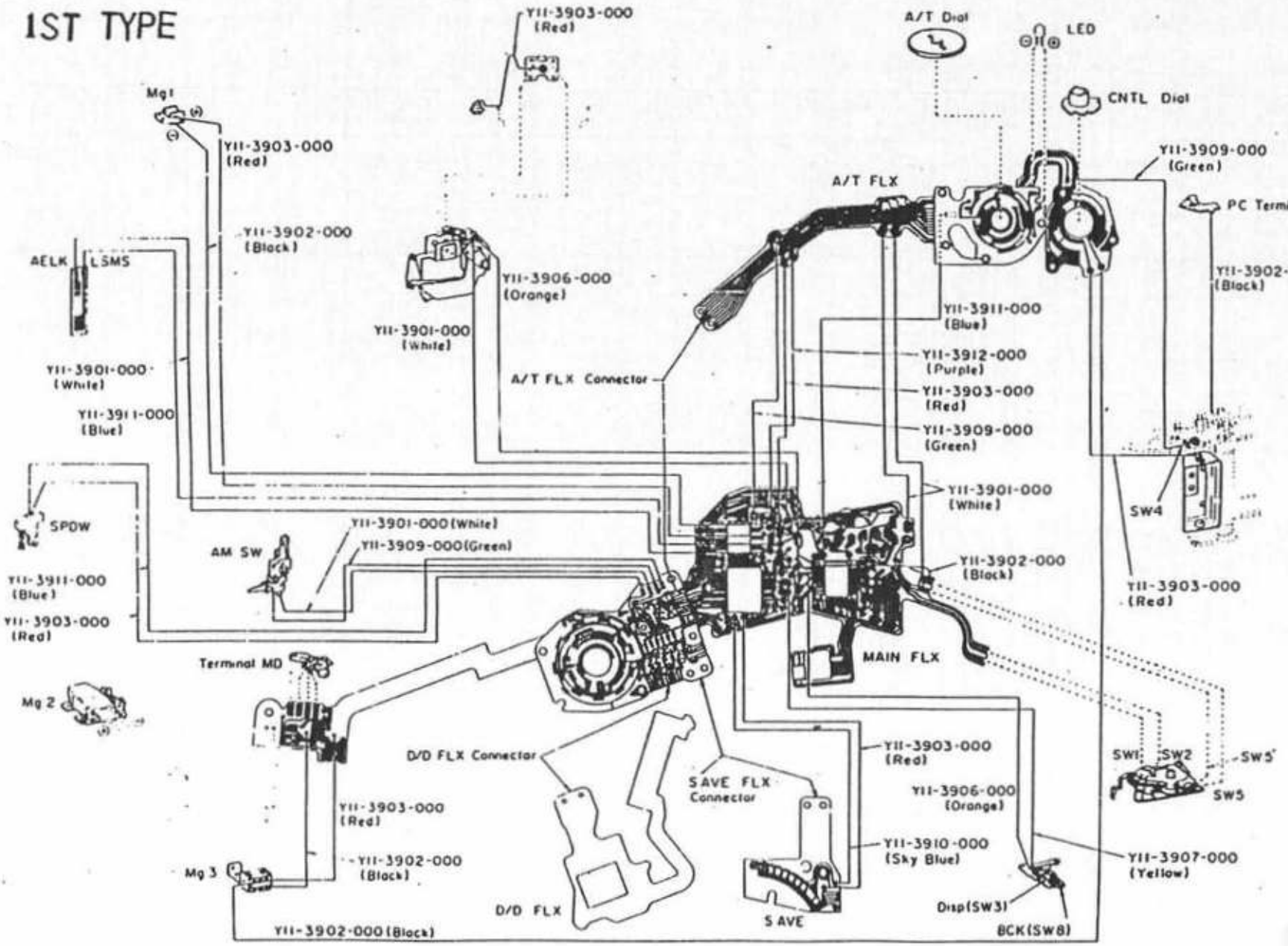
PARTS LIST

CHANGE PARTS DETAIL

MARK	PART NO.	CLASS	QTY	DESCRIPTION
	CA1-1163-000	0	1	SEAL, BATTERY
	CA1-4798-000	0	1	CONTACT, BATTERY
	CA1-4798-100	0	1	CONTACT, BATTERY
	CA1-3029-000	0	1	SEAL, BATTERY
	CF1-0231-000		1	BASE, WINDING
	CF1-0231-070		1	BASE, WINDING
	CF1-0236-000		1	SHAFT, WINDING
	CF1-0236-040		1	SHAFT, WINDING
	CG9-0068-000 (100)		1	CHARGE GEAR UNIT
	CG9-0068-001		1	CHARGE GEAR UNIT
	CG9-0072-000	C	1	BOX, BATTERY
	CS2-3186-000	0	1	SPRING, COIL
	CS2-3196-000	0	1	SPRING, COIL
	CY1-1066-000	0	1	BATTERY CONTACT UNIT
	XA1-1170-289		2	SCREW, CROSS-RECESS, PH

WIRING DIAGRAM

1ST TYPE



INDEX OF PARTS NUMBERS

NEW	PART NO.	PAGE	ADDRESS
	13-8503-000	11	B-13,14
	13-9011-000	5	B-1,2
	13-9894-000	10	B-11,12
	13-9991-000	11	B-13,14
	14-4498-000	10	B-11,12
		11	B-13,14
	97-3644-000	2	A-9,10
	97-3807-000	11	B-13,14
	CA1-0905-000	3	A-11,12
	CA1-0906-000	11	B-13,14
	CA1-0907-000	11	B-13,14
	CA1-0910-000	11	B-13,14
	CA1-0914-000	10	B-11,12
	CA1-0915-000	10	B-11,12
	CA1-0917-000	10	B-11,12
	CA1-0922-000	3	A-11,12
	CA1-0924-000	12	C-1,2
	CA1-0930-000	1	A-7,8
	CA1-0932-000	1	A-7,8
	CA1-0935-000	1	A-7,8
	CA1-0939-000	5	B-1,2
	CA1-0940-000	5	B-1,2
	CA1-0941-000	5	B-1,2
	CA1-0942-000	4	A-13,14
	CA1-0943-000	5	B-1,2
	CA1-0948-000	3	A-11,12
	CA1-0948-000	3	A-11,12
	CA1-0950-000	4	A-13,14
	CA1-0960-000	1	A-7,8
	CA1-0961-000	2	A-9,10
	CA1-0962-000	2	A-9,10
	CA1-0965-000	1	A-7,8
	CA1-0966-000	1	A-7,8
	CA1-0971-000	7	B-5,6
	CA1-0975-000	1	A-7,8
	CA1-0977-000	1	A-7,8
	CA1-0980-000	10	B-11,12
	CA1-0981-000	10	B-11,12
	CA1-0986-000	1	A-7,8
	CA1-0988-000	2	A-9,10
	CA1-0989-000	2	A-9,10
	CA1-0990-000	2	A-9,10
	CA1-0993-000	4	A-13,14
	CA1-0994-000	1	A-7,8
	CA1-0996-000	2	A-9,10
	CA1-1008-000	1	A-7,8
	CA1-1009-000	1	A-7,8
	CA1-1010-000	4	A-13,14
	CA1-1014-000	6	B-3,4
	CA1-1015-000	6	B-3,4
	CA1-1017-000	6	B-3,4
	CA1-1019-000	2	A-9,10
	CA1-1019-010	2	A-9,10
	CA1-1020-000	5	B-1,2
	CA1-1021-000	5	B-1,2
	CA1-1022-000	8	B-7,8
	CA1-1022-010	8	B-7,8
	CA1-1023-000	8	B-7,8
	CA1-1024-000	8	B-7,8
	CA1-1025-000	2	A-9,10
	CA1-1026-000	2	A-9,10
	CA1-1028-000	8	B-7,8
	CA1-1033-000	10	B-11,12
	CA1-1037-000	4	A-13,14
	CA1-1042-000	4	A-13,14
	CA1-1043-000	4	A-13,14
	CA1-1051-000	9	B-9,10
	CA1-1054-000	2	A-9,10
	CA1-1059-000	7	B-5,6
	CA1-1062-000	1	A-7,8
	CA1-1064-000	1	A-7,8
	CA1-1078-000	7	B-5,6
	CA1-1079-000	3	A-11,12
	CA1-1081-000	13	C-3,4
	CA1-1083-000	4	A-13,14
	CA1-1090-000	5	B-1,2
	CA1-1093-000	3	A-11,12
	CA1-1095-000	8	B-7,8
	CA1-1098-000	9	B-9,10
	CA1-1110-000	11	B-13,14
	CA1-1112-000	3	A-11,12
	CA1-1113-000	7	B-5,6
	CA1-1114-000	6	B-5,6
	CA1-1116-000	8	B-7,8
	CA1-1120-000	12	C-1,2
	CA1-1121-000	1	A-7,8
	CA1-1125-000	11	B-13,14
	CA1-1127-000	3	A-11,12
	CA1-1131-000	2	A-9,10
	CA1-1133-000	2	A-9,10
	CA1-1136-000	6	B-5,6
	CA1-1140-000	3	A-11,12
	CA1-1142-000	9	B-9,10
	CA1-1143-000	1	A-7,8
	CA1-1146-000	4	A-13,14
	CA1-1147-010	8	B-7,8
	CA1-1148-000	11	B-13,14
	CA1-1158-000	5	B-1,2
	CA1-1159-000	2	A-9,10
	CA1-1160-000	6	B-5,6
	CA1-1162-000	4	A-13,14
	CA1-1163-000	13	C-3,4
		14	C-5,6
	CA1-1240-000	11	B-13,14
	CA1-1264-000	10	B-11,12
	CA1-1394-000	4	A-13,14
	CA1-3397-000	2	A-9,10
	CA1-4707-000	3	A-11,12
	CA1-4708-000	4	A-13,14
	CA1-4709-000	3	A-11,12
	CA1-4716-000	2	A-9,10
	CA1-4717-000	10	B-11,12
	CA1-4718-000	11	B-13,14
	CA1-4727-000	11	B-13,14
	CA1-4744-000	10	B-11,12
	CA1-4761-000	13	C-3,4
	CA1-4770-000	13	C-3,4
	CA1-4774-000	12	C-1,2
	CA1-4776-000	13	C-3,4
	CA1-4785-000	13	C-3,4
	CA1-4787-000	12	C-1,2
	CA1-4788-000	13	C-3,4
	CA1-4794-000	12	C-1,2
	CA1-4798-000	14	C-5,6
	CA1-4798-100	14	C-5,6
	CA1-4801-000	13	C-3,4
	CA1-4814-000	12	C-1,2
	CA1-4815-000	12	C-1,2
	CA1-4816-000	12	C-1,2
	CA1-4817-000	12	C-1,2
	CA1-4821-000	3	B-1,2
	CA1-4822-000	12	C-1,2
	CA1-4823-000	4	A-13,14
	CA1-4831-000	3	A-11,12
	CA1-4840-000	2	A-9,10
	CA1-4848-000	6	B-5,6
	CA1-4853-050	8	B-7,8
	CA1-4855-000	8	B-7,8
	CA1-4906-000	8	B-7,8
	CA1-4930-000	7	B-5,6

INDEX OF PARTS NUMBERS

NEW	PART NO.	PAGE	ADDRESS
	CA1-4939-000	7	B-5,6
	CA1-4942-000	10	B-11,12
	CA1-4944-000	10	B-11,12
	CA1-4947-000	10	B-11,12
	CA1-4959-000	1	A-7,8
		3	A-11,12
	CA1-4998-000	7	B-5,6
	CA1-5012-000	7	B-5,6
	CA1-5014-000	13	C-3,4
	CA1-5015-000	3	A-11,12
	CA1-5019-000	11	B-13,14
	CA1-5029-000	13	C-3,4
	CA1-5030-000	2	A-9,10
	CA1-5036-000	2	A-9,10
	CA1-5040-000	2	A-9,10
	CA1-5044-000	3	A-11,12
	CA1-5049-000	11	B-13,14
	CA1-5062-000	12	C-1,2
	CA1-5064-000	2	A-9,10
	CA1-5065-000	2	A-9,10
	CA1-5066-000	2	A-9,10
	CA1-5067-000	2	A-9,10
	CA1-5074-000	2	A-9,10
	CA1-5090-000	1	A-7,8
	CA1-5096-000	10	B-11,12
	CA1-5097-000	1	A-7,8
	CA1-5100-000	11	B-13,14
	CA1-5101-000	4	B-5,6
	CA1-5105-050	4	A-13,14
	CA1-5108-000	11	B-13,14
	CA1-5121-000	2	A-9,10
	CA1-5124-000	5	B-1,2
	CA1-5124-020	5	B-1,2
	CA1-5125-000	1	A-7,8
	CA1-5129-010	8	B-7,8
	CA1-5130-000	8	B-7,8
	CA1-5137-000	2	A-9,10
	CA1-5147-000	11	B-13,14
	CA1-5152-000	1	A-7,8
	CA4-0838-000	2	A-9,10
	CF1-0230-000	11	B-13,14
	CF1-0230-010(192)	11	B-13,14
	CF1-0231-000	10	B-11,12
		14	C-5,6
	CF1-0231-070	10	B-11,12
		14	C-5,6
	CF1-0234-000	11	B-13,14
		14	C-5,6
	CF1-0234-040	11	B-13,14
		14	C-5,6
	CF1-0237-000	3	A-11,12
	CF1-0239-000	4	A-13,14
	CF1-0240-000	4	A-13,14
	CF1-0242-000	5	B-1,2
	CF1-0245-000	3	A-11,12
	CF1-0246-000	3	A-11,12
	CF1-0247-000	1	A-7,8
	CF1-0248-000	1	A-7,8
	CF1-0250-000	1	A-7,8
	CF1-0251-000	3	A-11,12
	CF1-0252-000	1	A-7,8
	CF1-0253-000	5	B-1,2
	CF1-0257-000	8	B-7,8
	CF1-0261-000	8	B-7,8
	CF1-0264-000	4	A-13,14
	CF1-0269-000	1	A-7,8
	CF1-0272-000	5	B-1,2
	CF1-0273-000	1	A-7,8
	CF1-0280-000	6	B-3,4
	CF1-0284-000	9	B-9,10
	CF1-0287-000	4	A-13,14
	CF1-0294-000	4	A-13,14
	CF1-0296-000	2	A-9,10
	CF1-0492-000	12	C-1,2
	CF1-0669-000	8	B-7,8
	CF1-1411-000	11	B-13,14
	CF1-1419-000	12	C-1,2
	CF1-1420-000	12	C-1,2
	CF1-1432-000	12	C-1,2
	CF1-1437-000	13	C-3,4
	CF1-1438-000	12	C-1,2
	CF1-1458-000	9	B-9,10
	CF1-1476-000	4	A-13,14
	CF1-1483-000	2	A-9,10
	CF1-1486-000	12	C-1,2
	CF1-1489-000	8	B-13,14
	CG1-0045-000	11	B-13,14
	CG1-0047-000	7	B-5,6
		9	B-9,10
	CG1-0048-000	7	B-5,6
		9	B-9,10
	CG1-0049-000	7	B-5,6
	CG1-0050-000	10	B-11,12
	CG1-0051-000	4	A-13,14
	CG1-0052-000	5	B-1,2
	CG1-0053-000	4	A-13,14
	CG1-0054-000	3	A-11,12
	CG1-0055-000	2	A-9,10
	CG9-0048-000	1	A-7,8
		2	A-9,10
	CG9-0051-000	1	A-7,8
	CG9-0055-000	10	B-11,12
	CG9-0056-000	1	A-7,8
	CG9-0059-000	5	B-1,2
	CG9-0061-000	3	A-11,12
	CG9-0063-000	4	A-13,14
	CG9-0068-000	10	B-11,12
	CG9-0068-000(100)	14	C-5,6
	CG9-0068-001	10	B-11,12
		14	C-5,6
	CG9-0072-000	14	C-5,6
	CG9-0073-000	12	C-1,2
	CG9-0094-000	10	B-11,12
	CG9-0095-000	12	C-1,2
	CG9-0149-000	8	B-7,8
	CG9-2502-000	8	B-7,8
	CG9-2524-000	11	B-13,14
	CH1-0154-000	7	B-5,6
	CH4-0003-000	24	D-10
	CH4-0004-000	23	D-9
	CH4-0005-000	23	D-9
	CH4-0006-000	23	D-9
	CH4-0007-000	23	D-9
	CH4-0008-000	23	D-9
	CH1-3001-000	7	B-5,6
	CH1-3003-000	6	B-3,4
	CH1-3083-000	6	B-3,4

PARTS LIST

ELECTRIC PARTS

SYMBOL	PART NO.	CLASS	DESCRIPTION	REMARKS
C47			CAPACITOR, TANTA.	47uF 6.3V
CAD			CAPACITOR, TANTA. (3RD TYPE)	1uF 10V
CBAI			CAPACITOR, TANTA.	47uF 6.3V
CCCC			CAPACITOR, TANTA.	1uF 10V
CCI	VC9-0126-000	D	CAPACITOR, TANTA. (1ST & 2ND TYPE)	33uF 6.3V
	VC9-0178-000	D	CAPACITOR, TANTA.	47uF 6.3V
			CAPACITOR, TANTA	22uF 6.3V
			CAPACITOR, TANTA. (3RD TYPE)	47uF 6.3V
CXVC			CAPACITOR, TANTA.	1uF 10V
CI			CAPACITOR, TANTA.	0.015uF 35V
CYCO			CAPACITOR, TANTA.	4.7uF 3.15V
DMG2			DIODE	1S2075K
DS+1			DIODE	1S2075K
DS+2			DIODE	1S2075K
CPU			IC (1ST TYPE)	SN28720
	CHA-0004-000	C	IC. (2ND & 3RD TYPE)	SN28741
I/O	CHA-0007-000	C	IC	SN28723
INPUT	CHA-0005-000	C	IC	SN28721
LEI			COIL	220 uH
OPI	CHA-0008-000	C	IC	SN28724
OSC/INTER-FACE	CHA-0006-000	C	IC	SN28722
LED	443-5279-000	D	LED	TLR-102
R140J	VR9-0326-000	D	RESISTOR	2.87KOHM 1/8W
RISET	VR9-0133-000	D	RESISTOR	2KOHM 1/8W
	VR9-0007-000	D	RESISTOR	2.2KOHM 1/8W
	VR9-0069-000	D	RESISTOR	2.4KOHM 1/8W
	VR9-0005-000	D	RESISTOR	2.7KOHM 1/8W
	VR9-0070-000	D	RESISTOR	3.0KOHM 1/8W
	VR9-0231-000	D	RESISTOR	3.32KOHM 1/8W
	VR9-0305-000	D	RESISTOR	3.65KOHM 1/8W
	VR9-0375-000	D	RESISTOR	4.02KOHM 1/8W
	VR9-0377-000	D	RESISTOR	4.42KOHM 1/8W
	VR9-0379-000	D	RESISTOR	4.87KOHM 1/8W
RAD NULL1				20KOHM 1/8W
RAD NULL2				20KOHM 1/8W
RAD NULL ADJ	VR9-0144-000	D	RESISTOR	10KOHM 1/8W
	VR9-0192-000	D	RESISTOR	15KOHM 1/8W
	VR9-0006-000	D	RESISTOR	22KOHM 1/8W
	VR9-0080-000	D	RESISTOR	33KOHM 1/8W
	VR9-0084-000	D	RESISTOR	47KOHM 1/8W
	VR9-0087-000	D	RESISTOR	68KOHM 1/8W
	VR9-0093-000	D	RESISTOR	120KOHM 1/8W
	VR9-0373-000	D	RESISTOR	270KOHM 1/8W

PARTS LIST

ELECTRIC PARTS & LEAD

SYMBOL	PART NO.	CLASS	DESCRIPTION	REMARKS
RB1			RESISTOR (1ST TYPE)	2.2 KOHM 1/8W
			RESISTOR (2ND & 3RD TYPE)	1 KOHM 1/8W
RB2			RESISTOR	9.1 KOHM 1/5W
R2.2			RESISTOR (1ST & 2ND TYPE)	2.2 KOHM 1/8W
RMG2			RESISTOR (3RD TYPE)	470 OHM 1/8W
R NULL 1				1 KOHM 1/8W
R NULL 2				1 KOHM 1/8W
R NULL ADJ	VR9-0508-000	D	RESISTOR	5.9 KOHM 1/8W
	VR9-0510-000	D	RESISTOR	6.49 KOHM 1/8W
	VR9-0117-000	D	RESISTOR	7.5 KOHM 1/8W
	VR9-0120-000	D	RESISTOR	8.66 KOHM 1/8W
	VR9-0144-000	D	RESISTOR	10 KOHM 1/8W
	VR9-0438-000	D	RESISTOR	13 KOHM 1/8W
	VR9-0372-000	D	RESISTOR	16 KOHM 1/8W
	VR9-0006-000	D	RESISTOR	22 KOHM 1/8W
	VR9-0080-000	D	RESISTOR	33 KOHM 1/8W
	VR9-0087-000	D	RESISTOR	68 KOHM 1/8W
RUSC	VR9-0513-000	D	RESISTOR	75 KOHM 1/8W
	VR9-0515-000	D	RESISTOR	82.5 KOHM 1/8W
	VR9-0517-000	D	RESISTOR	90.9 KOHM 1/8W
	VR9-0826-000	D	RESISTOR	100 KOHM 1/8W
	VR9-0521-000	D	RESISTOR	110 KOHM 1/8W
	VR9-0383-000	D	RESISTOR	121 KOHM 1/8W
	VR9-0387-000	D	RESISTOR	133 KOHM 1/8W
	VR9-0391-000	D	RESISTOR	147 KOHM 1/8W
	VR9-0395-000	D	RESISTOR	162 KOHM 1/8W
	VR9-0523-000	D	RESISTOR	178 KOHM 1/8W
	VR9-0525-000	D	RESISTOR	196 KOHM 1/8W
NTC			RESISTOR	2 KOHM 1/8W
TR			TRANSISTOR (1ST TPE)	2SA-728
	SA2-0118-000	D	TRANSISTOR (2ND & 3RD TYPE)	2SA-1115
VRC	CHA-0003-000	D	VARIABLE RESISTOR UNIT	
VRL				
VR1				
	Y11-3901-000		LEAD (WHITE)	
	Y11-3902-000		LEAD (BLACK)	
	Y11-3903-000		LEAD (RED)	
	Y11-3904-000		LEAD (ORANGE)	
	Y11-3907-000		LEAD (YELLOW)	
	Y11-3909-000		LEAD (GREEN)	
	Y11-3910-000		LEAD (SKY BLUE)	
	Y11-3911-000		LEAD (BLUE)	
	Y11-3913-000		LEAD (PURPLE)	

INDEX OF PARTS NUMBERS

MFR	PART NO.	PAGE	ADDRESS
CM1	1085-000	6	B-3,4
CS1	0151-000	11	B-13,14
CS1	0152-000	11	B-13,14
CS1	0154-000	11	B-13,14
CS1	0768-000	11	B-13,14
CS1	1768-000	11	B-13,14
CS1	4051-000	12	C-1,2
CS1	4407-000	6	B-3,4
CS1	4412-000	13	C-3,4
CS1	5083-000	10	B-11,12
CS1	5178-000	2	A-9,10
CS1	5179-000	9	B-9,10
CS1	5180-000	5	B-1,2
CS1	5181-000	5	A-11,12
CS1	5182-000	9	B-9,10
CS1	6103-000	4	A-13,14
CS1	6104-000	3	A-11,12
CS1	6105-000	12	C-1,2
CS1	6106-000	1	A-7,8
CS1	6107-000	6	B-3,4
CS1	6107-030	6	B-3,4
CS1	6108-000	7	B-5,6
CS1	6109-000	7	B-5,6
CS1	6110-000	7	B-5,6
CS1	6112-000	7	B-5,6
CS1	6113-000	11	B-13,14
CS1	6114-000	7	B-5,6
CS1	6115-000	10	B-11,12
CS1	6116-000	6	B-3,4
CS1	7222-000(020)	1	A-7,8
CS1	8151-000	4	A-13,14
CS1	8152-000	4	A-13,14
CS1	8153-000	1	A-7,8
CS1	8154-000	3	A-11,12
CS2	0337-000	11	B-13,14
CS2	0343-000	13	C-3,4
CS2	0344-000	12	C-1,2
CS2	0344-000	5	B-1,2
CS2	2634-000	12	C-1,2
CS2	2642-000	8	B-7,8
CS2	3184-000	12	C-1,2
CS2	3186-000	14	C-5,6
CS2	3189-000	8	B-7,8
CS2	3190-000	7	B-5,6
CS2	3191-000	7	B-5,6
CS2	3194-000	10	B-11,12
CS2	3196-000	14	C-5,6
CS2	4081-000	8	B-7,8
CS2	4081-040	8	B-7,8
CS2	4083-000	10	B-11,12
CS2	4083-080	10	B-11,12
CS2	4084-000	10	B-11,12
CS2	4086-000	12	C-1,2
CS2	4087-000	12	C-1,2
CS2	4088-000	12	C-1,2
CS2	4089-000	13	C-3,4
CS2	4091-000	12	C-1,2
CS2	4092-030	12	C-1,2
CS2	4093-000	5	B-1,2
CS2	4094-000	4	A-13,14
CS2	4095-000	9	B-9,10
CS2	4097-000	9	B-9,10
CS2	4098-000	9	B-9,10
CS2	4099-000	9	B-9,10
CS2	4100-000	9	B-9,10
CS2	4101-000	9	B-9,10
CS2	4102-000	9	B-9,10
CS2	4103-000	9	B-9,10
CS2	4104-000	8	B-7,8
CS2	4106-000	7	B-5,6
CS2	4111-030	7	B-5,6
CS2	4112-000	12	C-1,2
CS2	4114-000	8	B-7,8
CS2	4119-000	11	B-13,14
CS2	7019-000	8	B-7,8
CY1	1002-000	13	C-3,4
CY1	1005-000	13	C-3,4
CY1	1006-000	13	C-3,4
CY1	1007-000	13	C-3,4
CY1	1012-000	2	A-9,10
CY1	1013-000	7	B-5,6
CY1	1029-000	6	B-3,4
CY1	1030-000	13	C-3,4
CY1	1032-000	8	B-7,8
CY1	1035-000	11	B-13,14
CY1	1046-000	13	C-3,4
		14	C-5,6
CY4	9201-000	6	B-3,4
VC9	0126-000	23	D-9
VC9	0178-000	23	D-9
VR9	0003-000	23	D-9
VR9	0006-000	23	D-9
		24	D-10
VR9	0007-000	23	D-9
VR9	0069-000	23	D-9
VR9	0070-000	23	D-9
VR9	0080-000	23	D-9
		24	D-10
VR9	0084-000	23	D-9
VR9	0087-000	23	D-9
		24	D-10
VR9	0093-000	23	D-9
VR9	0117-000	24	D-10
VR9	0120-000	24	D-10
VR9	0133-000	23	D-9
VR9	0144-000	23	D-9
		24	D-10
VR9	0192-000	23	D-9
VR9	0231-000	23	D-9
VR9	0326-000	23	D-9
VR9	0372-000	24	D-10
VR9	0373-000	23	D-9
VR9	0375-000	23	D-9
VR9	0377-000	23	D-9
VR9	0379-000	23	D-9
VR9	0383-000	24	D-10
VR9	0387-000	24	D-10
VR9	0391-000	24	D-10
VR9	0395-000	24	D-10
VR9	0438-000	24	D-10
VR9	0505-000	23	D-9
VR9	0508-000	24	D-10
VR9	0510-000	24	D-10
VR9	0513-000	24	D-10
VR9	0515-000	24	D-10
VR9	0517-000	24	D-10
VR9	0521-000	24	D-10
VR9	0523-000	24	D-10

INDEX OF PARTS NUMBERS

MFR	PART NO.	PAGE	ADDRESS
VR9	0323-000	24	D-10
VR9	0826-000	24	D-10
WA1	0118-000	24	D-10
XA1	1140-169	13	C-3,4
XA1	1170-189	5	B-1,2
XA1	1170-209	11	B-13,14
XA1	1170-289	14	C-5,6
XA1	1170-309	6	B-3,4
XA1	1170-409	9	B-9,10
XA1	1170-809	4	A-13,14
XA1	1200-309	4	A-13,14
		10	B-11,12
		11	B-13,14
		13	C-3,4
XA1	1200-359	13	C-3,4
XA1	1200-409	4	A-13,14
XA1	1200-459	10	B-11,12
XA1	3170-209	8	B-7,8
		11	B-13,14
XA1	3170-229	6	B-3,4
		7	B-5,6
XA1	3170-259	1	A-7,8
		3	A-11,12
		7	B-5,6
XA1	3170-309	4	A-13,14
		8	B-7,8
XA1	3170-409	7	B-5,6
XA1	3200-259	11	B-13,14
XA1	3200-269	10	B-11,12
XA1	3200-359	13	C-3,4
XA1	3200-409	7	B-5,6
XA1	3200-559	4	A-13,14
XA1	3200-809	7	B-5,6
XA1	7170-229	12	C-1,2
XB7	2100-265	12	C-1,2
XD1	1101-321	4	A-13,14
XD1	1102-112	4	A-13,14
XD1	1102-120	7	B-5,6
		12	C-1,2
XD1	1102-121	7	B-5,6
		12	C-1,2
XD1	1102-122	7	B-5,6
		12	C-1,2
XD1	1102-130	8	B-7,8
		10	B-11,12
XD1	1102-131	10	B-11,12
XD1	1102-132	10	B-11,12
XD1	1103-120	10	B-11,12
XD1	1103-121	10	B-11,12
XD1	1104-131	4	A-13,14
XD1	1104-132	4	A-13,14
XD2	1100-102	3	A-11,12
XD2	1100-132	5	B-1,2
		9	B-9,10
		12	C-1,2
XD2	1100-132	10	B-11,12
XD2	1100-202	12	C-1,2
XC8	1100-571	1	A-7,8
X16	1701-380	8	B-7,8
X31	6222-590	13	C-3,4
X61	7215-000	12	C-1,2
X61	7216-000	9	B-9,10
X65	3279-000	4	A-13,14
		23	D-9
X71	9749-000	9	B-9,10
X71	9750-000	9	B-9,10
		10	B-11,12
		12	C-1,2
X91	1430-070	1	A-7,8
X91	1433-900	5	B-1,2
X91	1436-200	12	C-1,2
X91	1436-230	5	B-1,2
X91	1436-270	5	B-1,2
X91	1436-280	4	A-13,14
X91	1436-330	11	B-13,14
X91	1436-400	4	A-13,14
X91	1725-220	8	B-7,8
X91	1725-860	8	B-7,8
X91	1736-230	12	C-1,2
X91	1736-310	3	A-11,12
		4	A-13,14
X91	1736-320	2	A-9,10
X91	1736-360	1	A-7,8
X91	1736-380	11	B-13,14
X91	1736-440	7	B-5,6
X91	1736-550	9	B-9,10
X91	1736-560	4	A-13,14
X91	1736-570	10	B-11,12
X91	1736-590	10	B-11,12
X91	1736-660	1	A-7,8
X91	1736-690	5	B-1,2
		7	B-5,6
X91	2013-780	11	B-13,14
X91	2024-610	5	B-1,2
X91	2035-560	10	B-11,12
X94	1701-110	3	A-11,12
X94	1701-280	3	A-11,12
X93	2000-440	7	B-5,6
X96	1722-710	9	B-9,10
X96	1722-800	8	B-7,8
X96	1723-480	4	A-13,14
X96	1731-920	9	B-9,10
X96	1731-960	5	B-1,2
X98	0104-590	8	B-7,8
X98	0104-600	8	B-7,8
X98	0202-060	7	B-5,6
X98	0204-040	11	B-13,14
X98	0204-400	4	A-13,14
X98	0204-800	4	A-13,14
X98	0204-850	5	B-1,2
X98	0204-870	10	B-11,12
X98	0504-050	11	B-13,14
X98	0504-060	11	B-13,14
X98	0504-070	11	B-13,14
X98	0604-150	1	A-7,8
X98	0604-160	1	A-7,8
X98	0604-170	1	A-7,8
X98	0604-190	1	A-7,8

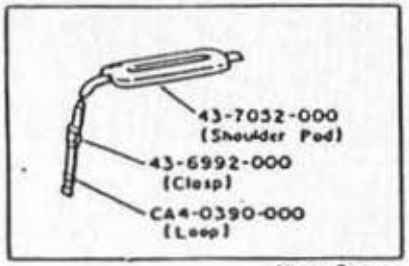
CASE L

INDEX OF PARTS NUMBERS

NEW	PART NO.	PAGE	ADDRESS
	X98-0404-200	1	A-7,8
	X98-0802-300	1	A-7,8
	X98-0802-310	1	A-7,8
	X98-0802-320	1	A-7,8
	X98-0903-810	1	A-7,8
	X98-0903-820	1	A-7,8
	X99-0312-000	2	A-9,10
	X99-0478-000	4	A-13,14
	Y11-3901-000	24	D-10
	Y11-3902-000	24	D-10
	Y11-3903-000	24	D-10
	Y11-3906-000	24	D-10
	Y11-3907-000	24	D-10
	Y11-3909-000	24	D-10
	Y11-3910-000	24	D-10
	Y11-3911-000	24	D-10
	Y11-3912-000	24	D-10

CA4-0385-000
(Battery Case)

Canon
97-9371-000(S)
(Name Plate)
97-9416-000(L)



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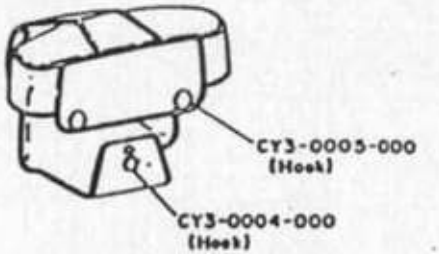

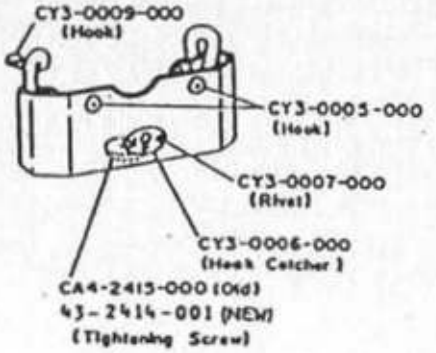

PARTS LIST

PART NO.	CLASS	QTY	DESCRIPTION
43-2414-001		1	TIGHTENING SCREW
43-6992-000		1	CLASP
43-7052-000		1	SHOULDER PAD
97-9371-000		1	NAME PLATE FOR CASE S
97-9416-000		1	NAME PLATE FOR CASE L
CA4-0385-000		1	BATTERY CASE
CA4-0390-000		1	LOOP
CA4-2415-000		1	TIGHTENING SCREW
CY3-0004-000		1	HOOK
CY3-0005-000		2	HOOK
CY3-0006-000		1	HOOK CATCHER
CY3-0007-000		1	RIVET
CY3-0009-000		1	HOOK